Attorney Docket No. 03398.000004.

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	YOUNGER AHLUWALIA	Art Unit: 1794
Serial No.:	10/766,652	Examiner: Ula C. Ruddock
Filed:	January 27, 2004	Confirmation No.: 3967
Title:	COMPOSITE MATERIAL	May 11, 2009

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Commissioner for Patents
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BRIEF ON APPEAL

This is an appeal from the final rejection of Claims 1-19 set forth in the Office Action dated November 12, 2008. A Notice of Appeal was filed on March 11, 2009. A payment of $540.00 for payment of the required fee set forth in 37 C.F.R. §41.20 (b)(2) has been paid concurrently herewith via the Electronic Filing System. The Commissioner is hereby authorized to charge any such fee determined to be due, and credit any overpayment, to Deposit Account No. 06-1205.

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BRIEF ON APPEAL

I. Real Party In Interest

The real party in interest is ElkCorp, the assignee of the instant application.

II. Related Appeals and Interferences

There are no related interferences. A related appeal was filed in U.S. Patent Application Numbers 10/354,220 and 10/766,649.

Appellant is not aware of any other appeals, judicial proceedings or interferences that will affect directly, will be affected directly by, or will otherwise have a bearing on, the decision in this appeal.

III. Status Of Claims

The status of the claims is as follows:

- Claims 1-19 stand finally rejected and are under appeal.

IV. Status Of Amendments

The claims have not been amended after the final Office Action of November 12, 2008 ("Final Office Action"). A copy of the appealed claims is attached as Section X, "Claims Appendix."

V. Summary Of Claimed Subject Matter

Appellant's claimed invention is generally directed to heat insulating and fire resistant composite materials. The heat insulating, fire resistant composite material may be used on its own or in conjunction with (*e.g.*, as a liner for) other materials. In

particular embodiments, the composite materials may be used in building materials (*e.g.*, gypsum board and siding materials, including sheathing), motor vehicles, heaters, dryers, mattresses, draperies, furniture upholstery, and the like.

For many years substrates such as fiberglass have been coated with various compositions to produce materials having utility in, among other applications, the building industry. Additionally, many different coating compositions have been formulated over the years but often such compositions would bleed through substrates, such as fiberglass substrates, if the substrates were coated on just one side, unless the compositions had a high binder content and/or included viscosity modifiers to enhance the viscosity of the coating composition. To prevent bleed through, such coating compositions sometimes had their viscosity increased by blowing or whipping air into the compositions. Although such blown compositions did not bleed through to the other side of mats such as fiberglass mats, the raw material costs for the compositions were high because of the numbers of constituent elements involved.

United States Patent No. 5,965,257 ("Ahluwalia '257"), assigned to the assignee of the present application, discloses a structural article having a coating, which includes only two major constituents, while eliminating the need for viscosity modifiers, stabilizers or blowing. The structural article of Ahluwalia '257 is made by coating a substrate having an ionic charge with a coating having essentially the same ionic charge. The coating consists essentially of a filler material and a binder material. By coating the substrate with a coating having essentially the same ionic charge, the patentee developed a zero bleed through product while using only two major ingredients in the coating and eliminating the need for costly and time consuming processing steps such as blowing.

Structural articles may thus be produced having a low binder content without the need for viscosity modifiers. ElkCorp produces a product in accordance with the invention of Ahluwalia '257 which is marketed as VersaShield®.

U.S. Patent No. 6,858,550 ("Ahluwalia '550"), to which the present application claims priority as a continuation-in-part application and which is assigned to the assignee of the present application, relates to fire resistant fabric materials comprising a substrate having an ionic charge coated with a coating having essentially the same charge and consisting essentially of a filler material and a binder material. The filler material includes clay. The fire resistant fabric material of Ahluwalia '550 is drapable and can be used as a fabric material or as a backing for a fabric material, such as a backing for mattress ticking.

The present invention is based in part on the unexpected discovery that the inclusion of a metallic component on the fire resistant fabric materials of Ahluwalia '550 surprisingly results in a composite material with superior heat insulating and fire resistant properties.

In the invention recited in appealed Claim 1, the heat insulating and fire resistant composite material comprises a substrate having an ionic charge, a coating which coats the substrate having essentially the same ionic charge, and a metallic component adhered to the coated substrate. *See, e.g.*, present specification, paragraphs 0021, 0023, 0047, and 0051. The coating of Claim 1 consists essentially of a filler material comprising clay and a binder material. *Id.* The binder material bonds the filler material together and to the substrate and the coating does not bleed through the substrate. *Id.*

In the invention recited in appealed Claim 16, the heat insulating and fire resistant composite material comprises a substrate which comprises glass fibers, wherein the composite material is from 5% to 10% by weight of the glass fibers; a coating which coats the substrate consisting essentially of a filler material comprising clay and a binder material, wherein the coating is from 80% to 90% wet weight of said composite material; and a metallic component adhered to the coated substrate, wherein said metallic component is from 5% to 10% by weight of said composite material. *See, e.g.*, present specification, paragraphs 0021, 0023, and 0044.

VI. Grounds of Rejection To Be Reviewed On Appeal

1. Whether Claims 1-19 are not obvious under 35 U.S.C. §103 over Ahluwalia '257 in view of United States Patent No. 4,600,634 ("Langer") and GB 2167060 ("GB '060") or United States Patent No. 4,994,317 ("Dugan") or United States Patent No. US 6,228,497("Dombeck")?

VII. The Cited Art

A. <u>U.S. 5,965,257 ("Ahluwalia '257")</u>

Ahluwalia '257, as discussed above, is assigned to the assignee of the present application and relates to a structural article having a coating, which includes only two major constituents, while eliminating the need for viscosity modifiers, stabilizers or blowing. The structural article of Ahluwalia '257 is made by coating a substrate having an ionic charge with a coating having essentially the same ionic charge. The coating consists essentially of a filler material and a binder material. By coating the substrate with a coating having essentially the same ionic charge, the patentee developed a zero bleed through product while using only two major ingredients in the coating and

eliminating the need for costly and time consuming processing steps such as blowing. Structural articles may thus be produced having a low binder content and no viscosity modifiers.

B. United States Patent No. 4,600,634 ("Langer")

Langer relates to a sheet material comprising an inorganic fiber, such as fiberglass; a binder, such as acrylic resin; and an inorganic endothermic filler, such as alumina trihydrate. Abstract. The "endothermic filler occupies the interstices between the fibers." Col. 4, lines 2-3. Clay is not listed among the fillers, but it is mentioned as an inorganic binder, on which the Langer "compositions do not rely." Col. 2, lines 53-54. Alternative embodiments feature the addition of a backing to the sheet material to "give added strength." *Id.*, lines 8-27. The backing materials may be aluminum foil or fabric scrim. *Id.*

C. GB 2167060 ("GB '060")

GB '060 relates to a fire resistant material comprising synthetic mineral fibers (including glass wool), clay and a binder. The fire resistant material is made by combining the components. The binder is preferably starch or modified starch; condensates of phenol, urea, melamine, resorcinol, tannin with aldehyde, isocyanates, reactive cements; binders formed in situ by inter-reaction between silica and calcium; hydraulic cements; and potassium and sodium silicates. The synthetic fibers, clay and binder are "suspended in a fluid, such as gases or liquids, followed by separation on a screen, with the fluid, or a portion thereof passing through said screen to leave a mat of solids which is subsequently pressed and/or dries to produce the product, and/or cure or set the binder." Page 3, lines 6-11.

D. United States Patent No. 4,994,317 ("Dugan")

Dugan relates to a flame barrier fabric comprising a textile fabric substrate, a silicone polymer coating carried by the surface of the textile fabric, and a reflective flame durable paint coating carried by the silicone polymer coating. Abstract. The silicone polymer coating may include flame retardant fillers, such as hydrated clay. Col. 3, lines 58-65. The silicone layer "fills the voids between the yarns," *i.e.*, enters the interstices between the fibers of the textile fabric substrate. Col. 4, lines 11-12.

E. United States Patent No. 6,228,497 ("Dombeck")

Dombeck relates to a high temperature resistant glass fiber composition that consists of glass fibers that are coated with a halogenated resin latex binder, a calcium carbonate material and a cationic flocculent. Abstract. Dombeck indicates that the latex binder is anionically stabilized and that the cationic flocculent is added to act as a coupling agent for the latex binder and calcium carbonate to the glass fibers. The high temperature resistant glass fibers are made by forming an aqueous dispersion including the glass fibers, binder, calcium carbonate and cationic flocculent (*i.e.,* a positively charged coating). The aqueous dispersion is then drained on a wire screen for dewatering to form a mat that is then dried by heated air. Col. 2, lines 64-67 through col. 3, lines 1-21. Dombeck states that other fillers may also be added, such as clay. Col. 5, line 28. Dombeck further states that the glass fibers are negatively charged and that "the excess positive charge on the flocculent causes the anionically stabilized, halogenated latex binder and the calcium carbonate or calcium magnesium carbonate to be deposited on the surface of the glass fibers." Col. 4, lines 29-36. Accordingly, Dombeck relates to a coating that has the opposite charge as the glass fibers.

VIII. Argument

Claims 1 and 16 are the sole independent claims appealed. All the appealed claims, Claims 1-19, stand rejected as obvious under 35 U.S.C. § 103(a). Appellant submits that the outstanding 35 U.S.C. § 103(a) rejection cannot be sustained for at least the reasons discussed below.

A. Introduction

As noted above, the instant application is a continuation-in-part of Application Serial No. 09/955,395, filed on September 18, 2001, which issued as U.S. Patent No. 6,858,550 ("Ahluwalia '550") on February 22, 2005, a copy of which is attached as Exhibit 1. The Examiner of the present application also examined Ahluwalia '550. Claim 1 of Ahluwalia '550 is as follows:

> 1. A fire resistant fabric material comprising a substrate having an ionic charge coated with a coating having essentially the same ionic charge,
>
> wherein said coating consists essentially of a filler material comprising clay and a binder material,
>
> wherein said binder material bonds the filler material together and to the substrate,
>
> wherein said coating does not bleed through said substrate, and
>
> wherein said fire resistant fabric material is dranable [sic] and has a porosity of between 5 and 50 cfm.

Ahluwalia '257 is listed as a cited reference on the first page of Ahluwalia '550. Ahluwalia '257 did not render the Ahluwalia '550 claims unpatentable and it should also not bar patentability of the instant claims.

The Examiner asserts that Ahluwalia '257 "discloses that it is well known to include clay as a filler material in structural articles in the building industry." As detailed below, Ahluwalia '257 provides only an acknowledgment that clay had been

used to fill the interstices between fibers in structural article sheets, not that clay could be used in coatings that did not bleed through such sheets.

In the BACKGROUND OF THE INVENTION in column 1 in Ahluwalia '257, there is a summary of prior art laminates made with facing sheets. It is noted that the laminates described in U.S. Patent No. 5,001,005 ("Blanpied") include thermosetting plastic foam and have planar facing sheets comprising glass fibers (exclusive of glass micro-fibers), non-glass filler material and non-asphaltic binder material. Col. 1, lines 17-21. Clay is one of the listed filler materials "that are bonded to the glass fibers using binders." A copy of Blanpied is attached as Exhibit 2.

The Blanpied patent relates to laminates and foam filled panel products. Col. 1, lines 7-8. In particular, Blanpied describes facer sheets for foamed core panels. *Id.*, lines 14-17. Prior art glass fiber sheets having a high porosity had been filled with "micro-fibers" and "fibrous glass dust" to decrease the porosity of the facer and contain the thermosetting plastic foams. *Id.*, lines 37-46. However, "micro-fibers" came to be regarded as hazardous to human safety. *Id.* lines 55-57. An asserted advantage of Blanpied was the provision of facers which lack micro-fibers. Col. 2, lines 10-12.

The facing sheets described in Blanpied include from 60% to 90% by weight glass fibers, exclusive of glass micro fibers; from 10% to 40% by weight non-glass filler material and from 1% to 30% by weight non-asphaltic binder. The filler may be clay. *Id.*, lines 36-43. The clay fills spaces in the glass fiber facing sheet. Col. 1, lines 41-46. A coating is mentioned only in Facer Example No. 3, and there it is indicated that a thermoplastic polymer latex is mixed with clay or another filler and with water and a water thickener. There is no suggestion that the coating does not bleed

through the mat. Indeed, the example states that the coating "reduces the porosity of shingle mat to the extent it can be used as a facer for thermosetting plastic foam boards." Col. 3, lines 66-68. Thus, Ahluwalia '257 and its reference to Blanpeid provides no indication that clay could be utilized in a zero bleed through coating.[1]

B. Claims 1-19 Are Not Obvious Under 35 U.S.C. § 103(a)

1. Claim 1
The Office Failed to Articulate a Proper *Prima Facie* Case of Obviousness

Appellant respectfully submits that the Office has failed to provide any rationale that can reasonably be construed as establishing a *prima facie* case of obviousness against Claim 1 and in particular the feature of "a coating which coats the substrate having essentially the same ionic charge . . . wherein said coating does not bleed through said substrate," as recited by Claim 1.

It is well established that the Office bears the burden of establishing a *prima facie case* of obviousness. *See* MPEP § 2142. If the examiner does not produce a *prima facie* case of obviousness, then the Appellant is under no obligation to submit evidence of nonobviousness. *Id.*

In *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007), the Supreme Court noted that it had previously set out a framework for applying the statutory language of § 103 in *Graham v. John Deere Co.*, 383 U.S. 1 (1966). In *Graham*, the Supreme Court held that:

> Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the

[1] It is also noted that the Blanpied patent indicates the possible utilization of aluminum foil elements. It is stated that structural laminates employing only the Blanpied facer may feature on the opposite side of the core prior art facers such as aluminum foil. The instant claims recite "a metallic component adhered to the coated substrate". Thus, the Blanpied patent does not describe a metal component adhered to a coated substrate.

> claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined.

Graham, 383 U.S. at 17 and 18 (emphasis added).

Referring to this framework set out in *Graham,* the Supreme Court in *KSR* further stated that "while the sequence of these questions might be reordered in any particular case, the factors continue to define the inquiry that controls." *KSR*, 550 U.S. at 404.

In *KSR,* the Supreme Court also reiterated the well-established principle that "rejections on obviousness cannot be sustained with mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *KSR,* 550 U.S. at 418, *citing In re Kahn,* 441 F.3d 977, 988 (Fed. Cir. 2006). *See also* MPEP § 2142 and *KSR,* 550 U.S. at 418 (quoting Federal Circuit statement with approval).

Thus, at the very least, in order to establish a *prima facie* case of obviousness, the Office must analyze the *Graham* factors and articulate reasoning with some rational underpinning to support the asserted obviousness conclusion. Merely relying on conclusory statements renders an asserted *prima facie* case of obviousness deficient.

The Final Office Action states that Appellant's response of July 28, 2008 is "not persuasive because Applicant cannot show non-obviousness by attacking references individually where, as here, the rejections are based on a combination of references." *See* Final Office Action, page 4. While Appellant agrees that the proposed combination must be considered as a whole, an analysis of each reference and what it

fairly teaches or suggests is necessary in evaluating the cited art. Moreover, Appellant also respectfully submits that a piecemeal analysis of each recitation in the claim without considering the breath of the claim as a whole is improper. *See* MPEP § 2106 II(C) ("Finally, when evaluating the scope of a claim, every limitation in the claim must be considered. USPTO personnel may not dissect a claimed invention into discrete elements and then evaluate the elements in isolation.").

Claim 1 recites, in part, "a coating which coats the substrate having essentially the same ionic charge . . . wherein said coating does not bleed through said substrate" (emphasis added). Thus, to establish a *prima facie* case of obviousness which accounts for the admittedly lacking features of Claim 1[2], the Office must analyze the *Graham* factors and articulate reasoning with some rational underpinning to support an asserted obviousness conclusion with respect to how the composite materials of Ahluwalia '257 could be reconstructed to include the admittedly lacking features of Claim 1 while maintaining a coating with essentially the same ionic charge as the substrate it coats and that does not bleed through the substrate, as proposed by the Office. *See* Final Office Action, pages 2-4.

Apparently the Final Office Action relies on Ahluwalia '257 as teaching the feature of "a coating which coats the substrate having essentially the same ionic charge . . . said coating does not bleed through said substrate." *See* Office Action, page 2. The invention described in Ahluwalia '257 is "a structural article made by coating a substrate having an ionic charge with a coating having essentially the same ionic charge.

[2] "Ahluwalia ['257] discloses the claimed invention except for the teaching that a metallic component is adhered to the coated substrate on one or both sides of the substrate and that the metallic component is from 5-10% by weight of said composite material and the specific teaching that clay is added to the coating." *See* Final Office Action, paragraph bridging pages 2 and 3, emphasis added.

The coating consists essentially of a filler material and a binder material." Col. 1, line 66 to col. 2, line 3. The filler is selected from the group consisting of fly ash, charged calcium carbonate, ceramic microspheres and mixtures thereof. Abstract, col. 2, line 21 to col. 3, line 4. The coating does not bleed through the substrate. Col. 2, lines 3 to 8. As noted in detail above, nothing in Ahluwalia '257 indicates that clay may be included among filler components to produce a coating that has essentially the same ionic charge as the substrate and thus not bleed through that substrate. Indeed, Ahluwalia distinguished his described and claimed invention from prior art laminates, such as Blanpied, that featured clay as a filler in the construction of planar facing sheets. The Ahluwalia '257 patent issued on October 12, 1999.

On September 18, 2001, Ahluwalia filed the application which issued as Ahluwalia '550. In that application, it was noted that the products of Ahluwalia '257

> are unable to provide a satisfactory fabric material because they lack adequate drapability characteristics. The applicant has discovered, however, that by including clay as a filler component in the coating of the article, a fire resistant fabric material may be produced which has satisfactory flexibility, pliability and drapability characteristics.

Ahluwalia '550, col. 2, lines 36-42. Thus, nearly two years after the issuance of Ahluwalia '257, Ahluwalia continued to distinguish the invention disclosed therein from products which included clay as a filler component.

The present invention, like that claimed in its ancestor Ahluwalia '550, includes a coated substrate wherein the "coating consists essentially of a filler material comprising clay and a binder material." *See* Ahluwalia '550 claim 1 and instant claim 1. In both instances the "coating does not bleed through said substrate." *Id.* The patented Ahluwalia '550 claims cover fire resistant materials that are "drapable" and that have "a porosity of between 5 and 50 cfm." The instant claims are directed to a heat insulating

and fire resistant composite material that comprises the aforementioned coated substrate and a metallic component adhered thereto. The coating consists essentially of a filler material comprising clay and a binder material which bonds the filler together and to the substrate, and wherein the coating does not bleed through the substrate. Nothing in Ahluwalia '257 suggests such a composite material. Indeed, the instant application states in paragraph 0014 that the "present invention is based in part on the unexpected discovery that the inclusion of a metallic component on the fire resistant fabric materials of U.S. Patent Application 09/955,395 [Ahluwalia '550] surprisingly results in a composite material with superior heat insulating properties and fire resistant properties that is still flexible."

The Examiner's attention is invited to two other of the instant application assignee's patents: U.S. Patent Nos. 6,586,353 to Kiik, Bryson, Tobin and Ahluwalia ("Kiik '353") and 6,673,432 to Kiik, La Vietes and Ahluwalia ("Kiik '432"), copies of which are attached as Exhibits 3 and 4, respectively. Kiik '353 is an ancestor to the present application and to Kiik '432.

Kiik '353 discloses a roofing underlayment system that comprises at least one layer of felt material and at least one layer of the coated structural article of Ahluwalia '257. Kiik '432 discloses a structural article comprising a substrate having an ionic charge coated on one side with the coating of Ahluwalia '257 and covered on the other side with a water vapor impermeable coating comprising a material selected from the group consisting of metal foils and preformed plastic films. Both Kiik '353 and Kiik '432 describe the filler component of the Ahluwalia '257 coating as a filler selected from the group consisting of fly ash, charged calcium carbonate, ceramic microspheres and

mixtures thereof. Neither Kiik '353 nor Kiik '432 indicates that clay may be included among the filler components and produce a coating that "does not bleed through" the substrate.

The Examiner has concluded that Ahluwalia '257 "discloses the claimed invention except for the teaching that the metallic component is adhered to the coated substrate." Essential to that conclusion is the Examiner's prior statement that Ahluwalia '257 "further discloses that it is well known to include clay as a filler material in structural articles in the building industry." *See* September 28, 2006 Office Action, page 2. But, as noted above, Ahluwalia '257 did not indicate that clay could be included in a coating that "does not bleed through" a substrate. Indeed, Ahluwalia '257 describes prior art, and then notes

> Many different coating compositions have been formulated over the years but often such compositions would bleed through substrates, such as fiberglass substrates, if the substrates were coated on just one side, unless the compositions had a high binder content and/or included viscosity modifiers to enhance the viscosity of the coating composition. To prevent bleed through, such coating compositions sometimes had their viscosity increased by blowing or shipping air into the compositions. Although such blown compositions did not bleed through to the other side of mats such as fiberglass mates, the raw material costs for the compositions were high because of the numbers of constituent elements involved.

> Accordingly, it is an object of this invention to provide a structural article having a coating which includes only two major constituents, while eliminating the need for viscosity modifiers, for stabilizers or for blowing. It is also an object of this invention to provide a low cost, relatively light weight structural article comprised principally of a coating having a low binder content and a high filler content. It is a further object of this invention to provide a relatively light weight, low cost coating which coats a substrate without bleeding through the substrate.

Col. 1, lines 42 to 53. Ahluwalia '257 specifies that the filler component of the inventive zero bleed through coating is selected from the group consisting of fly ash, charged calcium carbonate, ceramic microspheres and mixtures thereof. Clay is not included in that group.

The Examiner's rejection is also based on Langer which discloses a sheet material comprising an inorganic fiber, such as fiberglass; a binder, such as acrylic resin; and an inorganic endothermic filler, such as alumina trihydrate. Abstract. The "endothermic filler occupies the interstices between the fibers." Col. 4, lines 2-3. Clay is not listed among the fillers, but it is mentioned as an inorganic binder, on which the Langer "compositions do not rely." Col. 2, lines 53-54. Alternative embodiments feature the addition of a backing to the sheet material to "give added strength." *Id.*, lines 8-27. The backing materials may be aluminum foil or fabric scrim. *Id.*

The Examiner contends that it "would have been obvious to one having ordinary skill in the art to have added Langer's aluminum sheet to one or both sides of the coated substrate of Ahluwalia, motivated by the desire to create a structural article with increased strength and durability." The Applicants respectfully submit that, whether it would have been obvious to add Langer's aluminum sheet to the coated substrate of Ahluwalia '257 is irrelevant to the issue of patentability of the instant claimed invention.

In the present invention, the metallic component is adhered to the coated substrate of Ahluwalia '550 (a priority document of this application) not the coated substrate of Ahluwalia '257. As noted above, the Ahluwalia '257 coated substrate does not include clay among the coating components which do not bleed through the substrate. Indeed, Ahluwalia '257 distinguishes the inventive products described therein from prior art Blanpied facers which include clay to decrease the porosity in glass fiber sheets. Langer also employs filler, but not clay, to occupy "the interstices between fibers". Langer teaches that clay is not useful as a binder component.

The Examiner further relies on GB '060 which discloses a fire resistant material that is made by mixing synthetic mineral fibers, such as glass wool, with clay and a binder which are "suspended in a fluid, such as gases or liquids, followed by separation on a screen, with the fluid, or a portion thereof passing through said screen, to leave a mat of solids which is subsequently pressed and/or dried to produce the product, and/or cured to set the binder." Page 3, lines, 6-11. The Examiner's states that GB '060 discloses that "clays are selected to provide an endothermic reaction in the fire resistant material. However, as noted, there is nothing in GB '060 that would teach or even hint that clay can be included in a coating that "does not bleed through" a substrate.

The Examiner's rejection is also based on Dugan which relates to a flame barrier fabric comprising a textile fabric substrate, a silicone polymer coating carried by the surface of the textile fabric and a reflective flame durable paint coating carried by the silicone polymer coating. The silicone polymer coating may include flame retardant fillers, such as clay. Col. 3, lines 58-65. The silicone layer "fills the voids between the yarns," *i.e.,* enters the interstices between the fibers of the textile fabric substrate. Col. 4,

lines 11-12. Thus, Dugan actually teaches away from a coating comprising clay that "does not bleed through" a substrate.

In addition, the Examiner's rejection is based on Dombeck which relates to a high temperature resistant glass fiber composition that consists of glass fibers that are coated with a halogenated resin latex binder, a calcium carbonate material and a cationic flocculent. Abstract. Dombeck specifically teaches that the latex binder is anionically stabilized and that the cationic flocculent is added to act as a coupling agent for the latex binder and calcium carbonate to bind to the glass fibers. The high temperature resistant glass fiber composition of Dombeck is made by forming a positively charged coating comprising binder, calcium carbonate and cationic flocculent and forming an aqueous dispersion with the glass fibers to be coated, which is then drained on a wire screen for dewatering to form a mat that is then dried by heated air. Col. 2, lines 64-67 through co. 3, lines 1-21. Dombeck states that other fillers, such as clay, may be added to the positively charged coating. Col. 5, line 28. Dombeck teaches that the glass fibers are negatively charged and that "the excess positive charge on the flocculent causes the anionically stabilized, halogenated latex binder and the calcium carbonate or calcium magnesium carbonate to be deposited on the surface of the glass fibers." Col. 4, lines 29-36. Accordingly, Dombeck relates to a coating that has the opposite charge as the fibers it coats. Thus, Dombeck also teaches away from the present invention which relates to "a coating which coats the substrate having essentially the same ionic charge . . . wherein said coating does not bleed through said substrate."

The Final Office Action provides no rationale whatsoever as to how the composite materials disclosed in Ahluwalia '257 could be modified by Lange, GB '060,

Dugan and/or Dombeck in order to achieve a new composite material which includes the admittedly lacking elements of Claim 1 comprising a coating that does not bleed through the substrate. Nor does the Final Office Action provide any rationale as to how the composite materials disclosed in Ahluwalia '257 could be modified to include the admittedly lacking elements of Claim 1 while maintaining a coating with essentially the same ionic charge as the substrate it coats and that does not bleed through the substrate.

As further discussed below in detail, paragraphs 0049 and 0050 provide a comparison of the present invention and the Ahluwalia '257 coated substrate with aluminum foil adhered thereto. Note that a cotton ball was placed on top of both products and that the flame of a Bunsen Burner was placed two inches below them. The "cotton ball burned after 14 minutes when placed on top of a composite material comprised of aluminum foil and the structural article of U.S. Patent No. 5,965,257." Similar results were found with the Ahluwalia '550 composition, to which the present application claims priority. However, "the cotton ball did not burn even after 8.5 hours when placed on top of the composite material of the present invention which includes aluminum foil." Thus there are real and consequential differences between the coated substrates of Ahluwalia '257 and Ahluwalia '550, with the present invention.

The Office proposes modifying Ahluwalia '257 to incorporate the admittedly lacking features of Claim 1 but fails to articulate any reasoning as to how the characteristics of the Ahluwalia '257 composite materials would also exist in the Final Office Action's proposed composite material. These deficiencies in the Office's rejection are particularly concerning when the very reference that the Final Office Action relies on and proposes modifying, Ahluwalia '257, itself indicates that the prior art composite

materials, including those that utilize clay, require other complex and/or expensive constituents and/or steps to achieve a coating that does not bleed through the substrate. *See* Ahluwalia '257, Col. 1, lines 12-63. Without accounting for this required leap of logic, the Office has failed to meet its burden for establishing a *prima facie* case of obviousness.

The Examiner's attention is invited to the USPTO Examination Guidelines for Determining Obviousness, effective October 10, 2007. 72 Fed. Reg. 57,529 provides, *inter alia*, "Note that combining known prior art elements is not sufficient to render the claimed invention obvious if the results would not have been predictable to one of ordinary skill in the art." Nothing in Ahluwalia '257, Langer, GB '060, Dugan or Dombeck suggests that inclusion of clay among filler components produces a coating that does not bleed through a substrate and results in a product having superior heat insulating and fire resistant characteristics. Langer and Dugan teach the utilization of filler to occupy the interstices between fibers to decrease the porosity of glass fiber sheets. Dugan discloses clay as one such filler and Langer excludes its use as a binder. Dombeck teaches away from claim 1 because Dombeck teaches a coating having a positive charge, which may include clay, and a substrate having a negative charge, not a coating having essentially the same ionic charge as the substrate, wherein the coating does not bleed through the substrate. GB '060 teaches the suspension of fibers, fillers and binders in a fluid, wherein the fluid is subsequently drained and the remaining constituents dried or cured and is absent any teaching of a coating that does not bleed through a substrate. Ahluwalia '257 only summarizes the teaching of Blanpied with

respect to clay, but does not in any way indicate that clay may be utilized in a zero bleed through coating.

Furthermore, the Office's deficiencies in articulating a *prima facie* case of obviousness are additionally illustrated in the Advisory Office Action of February 18, 2009 ("First Advisory Office Action"). In Appellant's Request for Reconsideration of February 6, 2009, Appellant noted that the Office had failed to meet its burden for establishing a *prima facie* case of obviousness for the reasons stated above and requested that the Office articulate the purported supporting rationale, if any, that the Office was attempting to rely upon to reconcile how the characteristics of the Ahluwalia '257 composite materials would also exist after the Final Office Action's proposed modifications to the Ahluwalia '257 composite materials. *See* Request for Reconsideration of February 6, 2009, pages 2-4. In response, the First Advisory Action states "[t]his argument is not persuasive because Ahluwalia '257 does not suggest that the addition of clay would result in a coating that bleeds through the substrate." *See* First Advisory Action. Hence, the Office's sole rationale for establishing a *prime facie* case of obviousness relies on the presumption that features of a composite material disclosed in a reference will remain upon any modification <u>absent a teaching to the contrary</u>.

Appellant respectfully submits that the Office's reliance on this presumption demonstrates that the Office lacks any rationale to reconcile how the characteristics of the Ahluwalia '257 composite materials would exist after the Final Office Action's proposed modifications. As pointed out above, the Office bears the burden of establishing a *prima facie* case of obviousness against Claim 1 and in particular must analyze the *Graham* factors and articulate reasoning with some rational

underpinning to support an asserted obviousness conclusion. Here Ahluwalia '257, the other art relied upon (Langer, GB '060, Dugan and Dombeck), and the Final Office Action are completely absent of any reasoning with some rational underpinning to support the asserted obviousness conclusion by the Office. The Office is not relieved of its burden of establishing a *prima facie* case of obviousness merely because the primary reference relied upon does not recite a teaching adverse to the Office's proposed modifications. For at least these reasons, Appellant respectfully submits that the Office's reliance on this presumption fails to cure the above noted deficiencies in the Final Office Action's obviousness analysis.

For at least these reasons above, Appellant submits that the Office did not meet its burden for establishing a *prima facie* case of obviousness against Claim 1 in view of Ahluwalia '257, Langer, GB '060, Dugan, and Dombeck, and that the Final Office Action's mere conclusory statements are insufficient. Accordingly, the rejection under 35 U.S.C § 103(a) is believed obviated, and its withdrawal is respectfully requested.

2. Claims 1 and 16
The Combinations Recited in Claims 1 and 16
Are Not Obvious In View Of the Unexpected Results

The Final Office Action contends that it "would have been obvious to one having ordinary skill in the art to have added Langer's aluminum sheet to one or both sides of the coated substrate of Ahluwalia, motivated by the desire to create a structural article with increased strength and durability." In its responses of February 6, 2009 and March 11, 2009, Appellant respectfully submitted that even if the Final Office Action established the alleged *prima facie* case of obviousness, which as clearly shown above it

did not, it is properly rebutted in view of secondary considerations. *See* MPEP § 2141 V. Specifically, Appellant respectfully submitted that the cotton ball test discussed in paragraphs 49 and 50 of the present specification, and further elaborated upon below, clearly demonstrates that the results of the claimed combination are unexpected.[3]

In accordance with MPEP § 2141, the Office must consider unexpected results when determining whether a claimed combination is obvious. Apparently the Office did consider these unexpected results; however, the results were considered under an improper standard.

The First Advisory Office Action states that "[t]he test results in these paragraphs [i.e., paragraphs 49 and 50 of the present specification] <u>do not fairly compare the combination</u> of Ahluwalia, Langer, GB '260, Dugan, or Dombeck <u>to that of the present invention</u>" (emphasis added). The Advisory Office Action of April 23, 2009 ("Second Advisory Office Action"), advances a similar standard. Appellant respectfully submits that the Office has applied an improper standard when considering the evidence of unexpected results.

When the Office considers the weight of secondary considerations, such as unexpected results, the required nexus is between the claimed invention and the evidence of the secondary considerations. MPEP § 716.01(b). Moreover, when there is a nexus between the merits of the claimed invention and the evidence of secondary considerations, the evidence must be given substantial weight in the determination of obviousness. *Id.* "The ultimate determination of patentability must be based on consideration of the entire record, by a preponderance of evidence, with due

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[3] *See* Request for Reconsideration of February 6, 2009, pages 4-6, and Request for Reconsideration of March 11, 2009, pages 3 and 4.

consideration to the persuasiveness of any arguments and any secondary evidence." MPEP § 716.01(d). "If, after evaluating the evidence, the examiner is still not convinced that the claimed invention is patentable, the next Office action should include a statement to that effect and identify the reason(s)." *Id.*

In contrast to the Office's position, there is simply no requirement that the evidence of the secondary considerations "fairly compare" the Office's proposed combination of the art relied upon to Appellant's claimed invention. For at least this reason, the Office's obviousness analysis is believed deficient and should be withdrawn.

Appellant also notes that in order to achieve the alleged *prima facie* case of obviousness against Appellant's claimed invention, the Office has the burden of arriving at a legally permissible and technically feasible combination that addresses each limitation recited in Appellant's claims. Accordingly, *assuming arguendo*, that the Office did fulfill its burden of achieving the alleged *prima facie* case of obviousness, the Appellant's test results relating to the claimed invention should equate with the combination proposed by the Office. Evidence to the contrary would tend to demonstrate that the Office has failed to fulfill its burden, rendering the obviousness rationale relied upon deficient to start with. For at least these reasons, it is respectfully submitted that Appellant's test results are proper for evaluating secondary considerations of nonobviousness.

In Appellant's Request for Reconsideration dated February 6, 2009, Appellant provided test results rebutting any finding of obviousness which the Office discounted based on an improper standard. Accordingly, in the Request for Reconsideration of March 11, 2009, Appellant requested that the Office conduct an

obviousness analysis in view of the correct standard referenced above and discussed further in MPEP § 716. However, as indicated in the Second Advisory Office Action, the Office still apparently relies on the position that Appellant has not provided evidence which fairly compares the claimed invention to the combination of the art relied upon by the Office.

Appellant continues to request that the Office conduct an obviousness analysis in view of the correct standard. Should the Office continue to maintain the rejection, then the Office should clearly articulate the rationale relied upon for maintaining the rejection in view of Appellant's evidence of secondary considerations. *See* MPEP § 716.01(d) ("If, after evaluating the evidence, the examiner is still not convinced that the claimed invention is patentable, the next Office action should include a statement to that effect and identify the reason(s)."). Absent this analysis, the Office's obviousness analysis is deficient and should be withdrawn.

Furthermore, in accordance with MPEP § 716, Appellant respectfully submits that it has met its burden to properly rebut the alleged *prima facie* case of obviousness set forth by the Office. Particularly, the evidence of unexpected results establishes that the differences in results are in fact unexpected and unobvious and of both statistical and practical significance. *See* MPEP § 716.02(b).

As noted in Appellant's Requests of February 6 and March 11, the present invention is based, at least in part, on the unexpected discovery that the inclusion of a metallic component on the fire resistant fabric materials of priority application Ahluwalia '550, which is derived from the Ahluwalia '257 composite material to include a clay filler, surprisingly results in a composite material with superior heat insulating properties

and fire resistant properties that is still flexible. *See* paragraph 14 of the present specification. The Bunsen Burner-cotton ball tests conducted by Appellant clearly demonstrate the surprising superior heat insulating and fire resistant properties of the present invention.

As discussed in paragraphs 49 and 50 of the present specification, Appellant performed a cotton ball test to determine whether, when exposed to the flame of a Bunsen Burner, a cotton ball placed on top of the composite materials of the invention and on the other side of the flame, would be protected from the flame. Three samples were tested. Each of the three tested samples were derived from the very same primary reference, Ahluwalia '257 (owned by the assignee of the present application), that the Office proposes modifying to arrive at the presently claimed invention.

The three samples included in the test were:

1) the Ahluwalia '257 composite material (which does not include a clay filler) modified to have aluminum foil adhered thereto,

2) the Ahluwalia '550 composite material unmodified (which is the Ahluwalia '257 composite material modified to include a clay filler), and

3) the presently claimed invention (Ahluwalia '550 composite material modified to have aluminum foil adhered thereto).

Using the above numbering for the samples, the burn time for the cotton balls placed on top of sample #1 was 1 to 5 minutes, while the time to burn for the cotton balls placed on top of sample #2 was 14 minutes. In stark contrast however, the cotton balls placed on top of the sample #3 did not burn after 8.5 hours, which is more than 32X longer than either #1 or #2. These data points clearly indicate the unexpected superior

results of the invention. These results also show that the mere addition of aluminum foil or a clay filler to Ahluwalia '257, each on their own, failed to suggest the significant improvements demonstrated when both are included in the manner set forth in the presently claimed invention. These tests more than adequately demonstrate the existence of surprising and unexpected results to rebut the alleged obviousness rejection.

In view of the above unexpected results, Appellant respectfully submits that the claimed combination of elements is not obvious even if the Office could articulate a proper *prima facie* case of obviousness against Claims 1 and 16.

Therefore, Appellant respectfully requests that the rejection of Claims 1 and 16 under 35 U.S.C. § 103(a) as being unpatentable over Ahluwalia in view of Langer and GB '060 or Dugan or Dombeck be withdrawn.

3. Dependent Claims 2-15 The Office Failed to Articulate a Proper *Prima Facie* Case of Obviousness

The Final Office Action alleges that the proposed combination in view of Ahluwalia '257, Langer, GB '060, Dugan, and Dombeck teaches all the limitations of dependent Claims 2-15. Appellant respectfully disagrees. For all the reasons mentioned above in Section VIII A(1), Appellant asserts that the Office has failed to establish a *prima facie* case of obviousness against Claims 2-15 which all depend from Claim 1 directly or indirectly.

Accordingly, Appellant respectfully requests withdrawal of the 35 U.S.C § 103(a) rejection.

4. Dependent Claims 2-15 and 17-19 The Combinations Recited in Claims 2-15 and 17-19 Are Not Obvious In View Of the Unexpected Results

The Final Office Action alleges that the proposed combination in view of Ahluwalia '257, Langer, GB '060, Dugan, and Dombeck teaches all the limitations of dependent Claims 2-15 and 17-19. Appellant respectfully disagrees. For all the reasons mentioned above in Section VIII A(2), Appellant asserts that any alleged *prima facie* case of obviousness is properly rebutted in view of the evidence of unexpected results presented by Appellant.

Accordingly, Appellant respectfully requests withdrawal of the 35 U.S.C § 103(a) rejection.

IX. Conclusion

It is respectfully submitted that the final rejection of the claims should be reversed for the reasons stated.

Respectfully submitted,

Date: May 11, 2009

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X. Claims Appendix

1. A heat insulating and fire resistant composite material comprising:

(a) a substrate having an ionic charge;

(b) a coating which coats the substrate having essentially the same ionic charge; and

(c) a metallic component adhered to the coated substrate

wherein said coating consists essentially of a filler material comprising clay and a binder material, and wherein said binder material bonds the filler material together and to the substrate and wherein said coating does not bleed through said substrate.

2. The composite material according to claim 1, wherein said filler further comprises at least one other filler selected from the group consisting of decabromodiphenyloxide, antimony trioxide, fly ash, charged calcium carbonate, mica, glass microspheres and ceramic microspheres and said binder is acrylic latex.

3. The composite material according to claim 1, wherein said substrate is planar and is coated on one side with said coating.

4. The composite material according to claim 1, wherein said substrate is planar and is coated on both sides with said coating.

5. The composite material according to claims 3 or 4 wherein said metallic component is adhered to one side of said coated substrate.

6. The composite material according to claims 3 or 4 wherein said metallic component is adhered to both sides of said coated substrate.

7. The composite material according to claim 1 wherein the metallic component is selected from the group consisting of aluminum and stainless steel.

8. The composite material according to claim 7, wherein the metallic component is aluminum foil.

9. The composite material according to claim 1, wherein said material further includes on one or both sides a water repellent material.

10. The composite material according to claim 1, wherein said material further includes on one or both sides an antifungal material.

11. The composite material according to claim 1, wherein said material further includes on one or both sides an antibacterial material.

12. The composite material according to claim 1, wherein said material further includes on one or both sides a surface friction agent.

13. The composite material according to claim 1, wherein said material further includes on one or both sides a flame retardant material.

14. The composite material according to claim 1,wherein said material further includes on one or both sides an algaecide.

15. The composite material according to claim 1, wherein said material is colored with dye.

16. A heat insulating and fire resistant composite material comprising:

(a) a substrate which comprises glass fibers and wherein said composite material is from 5% to 10% by weight of the glass fibers;

(b) a coating which coats the substrate consisting essentially of a filler material comprising clay and a binder material, wherein the coating is from 80% to 90% wet weight of said composite material; and

(c) a metallic component adhered to the coated substrate, wherein said metallic component is from 5% to 10% by weight of said composite material.

17. The composite material according to claim 16 wherein said filler further comprises at least one filler selected from the group consisting of decabromodiphenyloxide, antimony trioxide, mica, fly ash, charged calcium carbonate, glass microspheres and ceramic microspheres.

18. The composite material according to claim 16, wherein the metallic component is selected from the group consisting essentially of aluminum and stainless steel .

19. The composite material according to claim 18, wherein the metallic component is aluminum foil.

XI. Evidence Appendix

A. Exhibit 1; U.S. Patent No. 6,858,550 (Ahluwalia '550)

B. Exhibit 2; U.S. Patent No. 5,001,005 (Blanpied)

C. Exhibit 3; U.S. Patent No. 6,586,353 (Kiik '353)

D. Exhibit 4; U.S. Patent No. 6,673,432 (Kiik '432)

XII. Related Proceedings Appendix

1. Board decision in U.S. Application No. 10/354,220

FCHS_WS 3234316_1

Exhibit 1

US006858550B2

(12) United States Patent
Ahluwalia

(10) **Patent No.: US 6,858,550 B2**
(45) **Date of Patent: Feb. 22, 2005**

(54) **FIRE RESISTANT FABRIC MATERIAL**

(75) Inventor: **Younger Ahluwalia**, Desoto, TX (US)

(73) Assignee: **Elk Premium Building Products, Inc.**, Dallas, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(58) **Field of Search** 442/59, 64, 65, 442/66, 70, 67, 71, 79, 97, 101, 123, 136, 130; 428/920, 921

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U.S. PATENT DOCUMENTS

4,229,329 A		10/1980	Bennett	
4,495,238 A		1/1985	Adiletta	
4,745,032 A		5/1988	Morrison	
4,746,565 A		5/1988	Bafford et al.	428/251
4,784,897 A		11/1988	Brands et al.	
4,994,317 A	*	2/1991	Dugan et al.	442/72
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5,091,243 A		2/1992	Tolbert et al.	
5,965,257 A		10/1999	Ahluwalia	
6,051,193 A	*	4/2000	Langer et al.	422/179
6,228,497 B1	*	5/2001	Dombeck	428/392
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State of California Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation Technical Bulletin 129, Oct. 1992, *Flammability Test Procedure for Mattresses for use in Public Buildings*.

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(57) **ABSTRACT**

A fire resistant fabric material comprising a substrate having an ionic charge which is coated with a coating having essentially the same ionic charge. The coating consists essentially of a filler material comprising clay and a binder material. The substrate is preferably fiberglass, the filler material may further comprise at least one additional filler selected from the group consisting of decabromodiphenyloxide, antimony trioxide, fly ash, charged calcium carbonate, mica, glass microspheres and ceramic microspheres and mixtures thereof and the binder material is preferably acrylic latex.

13 Claims, No Drawings

FIRE RESISTANT FABRIC MATERIAL

BACKGROUND OF THE INVENTION

This invention relates to fire resistant fabric materials comprising a substrate having an ionic charge coated with a coating having essentially the same charge and consisting essentially of a filler material and a binder material. The filler material includes clay.

For many years substrates such as fiberglass have been coated with various compositions to produce materials having utility in, among other applications, the building industry. U.S. Pat. No. 5,001,005 relates to structural laminates made with facing sheets. The laminates described in that patent include thermosetting plastic foam and have planar facing sheets comprising 60% to 90% by weight glass fibers (exclusive of glass micro-fibers), 10% to 40% by weight non-glass filler material and 1% to 30% by weight non-asphaltic binder material. The filler materials are indicated as being clay, mica, talc, limestone (calcium carbonate), gypsum (calcium sulfate), aluminum trihydrate (ATH), antimony trioxide, cellulose fibers, plastic polymer fibers or a combination of any two or more of those substances. The patent further notes that the filler materials are bonded to the glass fibers using binders such as urea-, phenol- or melamine-formaldehyde resins (UF, PF, and MF resins), or a modified acrylic or polyester resin. Ordinary polymer latexes used according to the disclosure are Styrene-Butadiene-Rubber (SBR), Ethylene-Vinyl-Chloride (EVCl), PolyVinylidene Chloride (PvdC), modified PolyVinyl Chloride (PVC), PolyVinyl Alcohol (PVOH), and PolyVinyl Acetate (PVA). The glass fibers, non-glass filler material and non-asphaltic binder are all mixed together to form the facer sheets.

U.S. Pat. No. 4,745,032 discloses an acrylic coating comprised of one acrylic underlying resin which includes fly ash and an overlying acrylic resin which differs from the underlying resin.

U.S. Pat. No. 4,229,329 discloses a fire retardant coating composition comprising fly ash and vinyl acrylic polymer emulsion. The fly ash is 24 to 50% of the composition. The composition may also preferably contain one or more of a dispersant, a defoamer, a plasticizer, a thickener, a drying agent, a preservative, a fungicide and an ingredient to control the pH of the composition and thereby inhibit corrosion of any metal surface to which the composition is applied.

U.S. Pat. No. 4,784,897 discloses a cover layer material on a basis of a matting or fabric which is especially for the production of gypsum boards and polyurethane hard foam boards. The cover layer material has a coating on one side which comprises 70% to 94% powdered inorganic material, such as calcium carbonate, and 6% to 30% binder. In addition, thickening agents and cross-linking agents are added and a high density matting is used.

U.S. Pat. No. 4,495,238 discloses a fire resistant thermal insulating composite structure comprised of a mixture of from about of 50% to 94% by weight of inorganic microfibers, particularly glass, and about 50% to 6% by weight of heat resistant binding agent.

U.S. Pat. No. 5,091,243 discloses a fire barrier fabric comprising a substrate formed of corespun yarns and a coating carried by one surface of the substrate. The coating comprises a carbonific compound, a catalyst and a source of a non-flammable gas. The coating additionally comprises thickening agents and blowing agents.

Many different coating compositions have been formulated over the years but often such compositions would bleed through substrates, such as fiberglass substrates, if the substrates were coated on just one side, unless the compositions had a high binder content and/or included viscosity modifiers to enhance the viscosity of the coating composition. To prevent bleed through, such coating compositions sometimes had their viscosity increased by blowing or whipping air into the compositions. Although such blown compositions did not bleed through to the other side of mats such as fiberglass mats, the raw material costs for the compositions were high because of the numbers of constituent elements involved.

U.S. Pat. No. 5,965,257, the entire disclosure of which is incorporated herein by reference, discloses a structural article having a coating which includes only two major constituents, while eliminating the need for viscosity modifiers, for stabilizers or for blowing. The structural article of U.S. Pat. No. 5,965,257 is made by coating a substrate having an ionic charge with a coating having essentially the same iconic charge. The coating consists essentially of a filler material and a binder material. By coating the substrate with a coating having essentially the same ionic charge, the patentee developed a zero bleed through product while using only two major ingredients in the coating and eliminating the need for costly and time consuming processing steps such as blowing. Structural articles may thus be produced having a low binder content and no viscosity modifiers. U.S. Pat. No. 5,965,257 issued to Elk Corporation of Dallas, the assignee of the present application. Elk produces a product in accordance with the invention of U.S. Pat. No. 5,965,257 which is marketed as VersaShield®.

As indicated in U.S. Pat. No. 5,965,257, VersaShield® has many uses. However, it has been found that the products of U.S. Pat. No. 5,965,257 are unable to provide a satisfactory fabric material because they lack adequate drapability characteristics. The applicant has discovered, however, that by including clay as a filler component in the coating of the article, a fire resistant fabric material may be produced which has satisfactory flexibility, pliability and drapability characteristics.

SUMMARY OF THE INVENTION

The present invention relates to a fire resistant fabric material comprising a substrate having an ionic charge coated with a coating have essentially the same ionic charge. The substrate may be any suitable reinforcement material capable of withstanding processing temperatures and is preferably fiberglass. The coating is comprised principally of a filler and a binder. The binder is preferably acrylic latex and the filler comprises clay and may further include an additional filler selected from the group consisting of antimony trioxide, decabromodiphenyloxide, charged calcium carbonate, fly ash, mica, glass or ceramic microspheres and mixtures thereof.

The fire resistant fabric material may be used on its own or in conjunction with (e.g. as a liner for) a decorative fabric which may itself be fire resistant. The present invention also relates to an article of manufacture comprising the fire resistant fabric material including, inter alia, mattress fabrics, mattress covers, upholstered articles, building materials, bedroom articles, (including children's bedroom articles), draperies, carpets, tents, awnings, fire shelters, sleeping bags, ironing board covers, barbecue grill covers, fire resistant gloves, engine liners, and fire-resistant clothing

for race car drivers, fire fighters, jet fighter pilots, and the like. The use of the fire resistant fabric materials of the present invention for manufacturing fabrics for use in articles such as mattresses, cribs, drapes and upholstered furniture, may enable the article to exceed current flammability standards for these types of articles.

DETAILED DESCRIPTION

In accordance with the invention, a fire resistant fabric material is made by coating a substrate having an ionic charge with a coating having essentially the same ionic charge. The coating consists essentially of a filler material and a binder material. By coating the substrate with a coating having essentially the same ionic charge, the applicant has developed a fire resistant fabric material while using mainly two major ingredients in the coating and eliminating the need for viscosity modifiers, thickening agents and costly and time consuming processing steps such as blowing.

The coated substrate of the present invention may be any suitable reinforcement material capable of withstanding processing temperatures, such as glass fibers, polyester fibers, cellulosic fibers, asbestos, steel fibers, alumina fibers, ceramic fibers, nylon fibers, graphite fibers, wool fibers, boron fibers, carbon fibers, jute fibers, polyolefin fibers, polystyrene fibers, acrylic fibers, phenolformaldehyde resin fibers, aromatic and aliphatic polyamide fibers, polyacrylamide fibers, polyacrylimide fibers or mixtures thereof which may include bicomponent fibers.

Examples of substrates in accordance with the invention include, inter alia, glass, fiberglass, ceramics, graphite (carbon), PBI (polybenzimidazole), PTFE, polyaramides, such as KEVLAR™ and NOMEX™, metals including metal wire or mesh, polyolefins such as TYVEK™, polyesters such as DACRON™ or REEMAY™, polyamides, polyimides, thermoplastics such as KYNAR™ and TEFZEL™, polyether sulfones, polyether imide, polyether ketones, novoloid phenolic fibers such as KYNOL™, KoSa™ polyester fibers, JM-137 M glass fibers, Owens-Corning M glass, Owens-Corning K glass fibers, Owens-Corning H glass fibers, Evanite 413M glass microfibers, Evanite 719 glass microfibers, cellulosic fibers, cotton, asbestos and other natural as well as synthetic fibers. The substrate may comprise a yarn, filament, monofilament or other fibrous material either as such or assembled as a textile, or any woven, non-woven, knitted, matted, felted, etc. material. The polyolefin may be polyvinyl alcohol, polypropylene, polyethylene, polyvinyl chloride, polyurethane, etc. alone or in combination with one another. The acrylics may be DYNEL, ACRILAN and/or ORLON. RHOPLEX AC-22 and RHOPLEX AC-507 are acrylic resins sold by Rohm and Haas which nay also may be used. The cellulosic fibers may be natural cellulose such as wood pulp, newsprint, Kraft pulp and cotton and/or chemically processed cellulose such as rayon and/or lyocell. Nonlimiting examples of non-woven materials that may be useful in the present invention include non-woven, continuous fiberglass veils, such as Firmat™ 100, Pearlveil™ 110, Pearlveil™ 210, Curveil™ 120, Curveil™ 220, Flexiveil™ 130, Flexiveil™ 230 and Pultrudable veil (all available from Schmelzer Industries, Inc., Somerset, Ohio). The woven materials may be Airlaid™, Spunbond™ and Needlepunch™ (available from BFG Industries, Inc. of Greensboro, N.C.). Nonlimiting examples of filament materials include D, E, B, C, DE, G, H, K filaments of various grades, including electrical grade, chemical grade and high strength grade (all available from BFG Industries, Inc. of

Greensboro, N.C.). In a preferred embodiment, the substrate is a woven fiberglass mat. As used herein, a fiberglass mat includes nonwoven and woven fiberglass mats.

As stated above, the filler material of the present invention preferably includes clay. The clay may be Paragon™, which is soft clay (i.e. it is soft to the touch), Suprex™, which is hard clay (i.e. it is hard to the touch), Suprex™ amino silane treated clay, which is used for crosslinking, since it will chemically bond with binder, and for highloading and Ballclay™, which has elastic properties (i.e. it feels rubbery). All of above-listed clay products are available, for example, from Kentucky-Tennessee Clay Company of Langley, S.C. In a preferred embodiment, the clay is Ballclay™ 3380 which is particularly inexpensive compared to other clays. In the present invention, clay is preferred because of its elongation properties (it has a low modulus), its abrasion resistance, its tear resistance, and its tensile strength. Moreover, clay is a good heat barrier; it does not disintergate when an open flame (temperature≧1500° F.) is applied directly to a coating of the present invention that includes clay. In addition, clay provides a slick, elastic, glassy surface which exhibits flexibility. Furthermore, as noted, clay is inexpensive and thus can provide a low cost fabric material.

The filler material may further comprise an additional filler selected from the group consisting of decabromodiphenyloxide, antimony trioxide, charged calcium carbonate, fly ash (such as Alsil O4TR™ class F fly ash produced by JTM Industries, Inc. of Martin Lake and Jewett, Tex. which has a particle size such that less than 0.03% remains on an agitated 0.1 inch X 0.1 inch screen), 3-X mineralite mica (available from Engelhard, Inc. of Louisville, Ky.) and glass or ceramic microspheres (glass microspheres are 2.5 times lighter than ceramic microspheres and also provide fire resistance), or any mixture of these filler materials to meet desired cost and weight criteria. Glass and ceramic microspheres are manufactured by Zeelan Industries of 3M Center Bldg., 220-8E-04, St. Paul, Minn. 55144-1000. Calcium carbonate may be obtained from Franklin Industrial Minerals of 612 Tenth Avenue North, Nashville, Tenn. 37203.

Calcium carbonate, talc and fly ash filler increase the weight of the product, but utilization of glass and/or ceramic microspheres enables the manufacture of a product with reduced weight and increased fire resistant properties. Clay may impart to the product the following nonlimiting characteristics: (1) lower heat build-up, (2) heat reflectance properties, (3) fire barrier properties, (4) no weight loss when exposed to heat and open flame, and (5) reduced disintegration when exposed to heat and open flame. Decabromodiphenyloxide and antimony trioxide impart the following nonlimiting characteristics: (1) flame retardant properties, (2) capability of forming a char, and (3) capability of stopping the spread of flames.

Glass and ceramic microspheres can withstand heat greater than 2000° F. Also, glass and ceramic microspheres increase compressive strength, absorb no latex and/or water and thus permit the faster drying of the product. Glass and ceramic microspheres also increase product flexibility.

Further, the glass and ceramic microspheres help to increase the pot life of the coating. Heavier particles in the fillers, although they may comprise but a small percentage of the particles in the filler, have a tendency to settle near the bottom of a storage vessel. When glass and/or ceramic microspheres are mixed together with another filler, a dispersion is produced which has an increased pot life or shelf

life. Without wishing to be bound by any particular theory, it is believed that as the filler particles naturally fall in the vessel and the glass and ceramic microspheres rise, the smaller size filler particles are supported by the glass and/or ceramic microspheres, thus enabling the microspheres to stay in solution and preventing the filler particles, to at least some extent, from descending to the bottom of the vessel.

The use of the fire resistant fabric materials of the present invention for manufacturing fabrics for use in articles such as mattresses, cribs, drapes and upholstered furniture, may enable the article to exceed current flammability standards for these types of articles. While flammability standards for mattresses have not specifically been set by the federal or state governments, some government agencies have provided recommended guidelines.

For example, the United States Department of Commerce National Institute of Standards and Technology (NTIS) in Gaithersburg, Maryland has published a paper relating to a methodology for assessing the flammability of mattresses. See T. J. Ohlemiller et al., *Flammability Assessment Methodology for Mattresses*, NISTIR 6497, June 2000. While no clear standard is given, it is recommended that a mattress be able to withstand the described test procedures. The NTIS has noted that beds pose a unique fire hazard problem and provide a series of tests for determining the flammability of mattresses. In addition, the State of California Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation ("the Bureau") issued a Technical Bulletin in October 1992 which provides a flammability test procedure for mattresses. See State of California Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation Technical Bulletin 129, October 1992, *Flammability Test Procedure for Mattresses for use in Public Buildings*. The technical bulletin provides standard methods for fire testing of mattresses. The methods produce data describing the burning behavior from ignition of a mattress until all burning has ceased, or after a period of one hour has elapsed. The rate of heat release is measured by an oxygen consumption technique. The Bureau indicates that mattresses complying with the test method will be safer and hopes that manufacturers will attempt to manufacture mattresses which pass the recommended tests. The Bureau indicates that "a mattress fails to meet the requirements of the test if any of the following criteria are exceeded:" (1) weight loss of 3 pounds or greater within the first 10 minutes due to combustion, (2) a maximum rate of heat release of 100 kW or greater, and (3) a total heat release of 25 MJ or greater in the first 10 minutes. A mattress manufactured with the fire resistant fabric material of the present invention is anticipated to comply with or exceed the test standards recommended both by the NTIS and the California Bureau. See Example 1 below.

As indicated above, the fire resistant fabric material of the present invention is usefull in the manufacture of mattresses. In this embodiment of the invention, the fire resistant fabric material may be used to line a decorative fabric to produce a fire resistant mattress fabric. The lining may be achieved by methods known in the art. For example, the fire resistant fabric material of the present invention may simply be placed under a decorative fabric. Or, the fire resistant mattress material may be adhered to the decorative fabric, for example using a flexible and preferably nonflammable glue or stitched with fire resistant thread i.e., similar to a lining. The fire resistant mattress fabric of the present invention may then be used by the skilled artisan to manufacture a mattress which has improved flammability characteristics.

The table below provides, in percentages, the components of the coating the applicants have used in a preferred embodiment of the invention.

TABLE I

Coating Components	% Wet	% Dry
BINDER		
BFG Hycar ™ 2679 Latex	25.000	23.123
Cymel ™ 373	3.700	5.877
Rhoplex ™ TR-407	4.500	3.826
FILLER		
Clay-mattress grade	22.600	42.229
Antimony trioxide	3.000	5.606
Decabromodiphenyloxide	9.000	16.817
WATER REPELLANT MATERIAL		
Natrosol HEC ™	0.050	0.093
Aurapel-391 ™	2.500	1.168
Acrysol ™ ASE-95NP	0.500	0.168
MISCELLANEOUS		
Water	27.470	0.000
Ammonium Hydroxide	1.130	0.591
Y-250 defoamer	0.100	0.185
W-4123 Blue Pigment	0.500	0.318
Total Percentage	100%	100%

Although the table shows possible combinations of clay, decabromodiphenyloxide and antimony trioxide in the filler component of the coating, it is believed that other combinations of clay with the fillers listed above may be employed. For example, the decabromodiphenyloxide and antimony trioxide levels can be reduced and/or replaced with clay but the levels of these non-clay filler constituents are preferably not increased. Any changes in the combination of fillers should maintain the density, viscosity, fire resistance properties and low cost coating. The density, viscosity and fire resistance properties can be ascertained by the skilled artisan and are further described in Example 1 below.

The coating is prepared by using a binder material such as a high performance heat-reactive acrylic latex polymer to bond the filler materials together and to bond the filler to the substrate. Such a binder material is Hycar™ 2679 acrylic latex polymer supplied by B. F. Goodrich Company of Cleveland, Ohio. Binder components may also include Cymel™ 373 (available from American Cyanamid), RHOPLEX™ TR 407 and R&H GL-618 latex both available from Rohm & Haas, and Borden FG-413F UF resin (available from Borden). It is believed, however, that any linear polymer, linear copolymer or branched polymer may be useful in preparing the coating. Possible binder materials include butyl rubber latex, SBR latex, neoprene latex, polyvinyl alcohol emulsion, SBS latex, water based polyurethane emulsions and elastomers, vinyl chloride copolymers, nitrile rubbers and polyvinyl acetate copolymers.

The coating comprises approximately 50% by weight of the fire resistant fabric material. In the coating, about 20% to about 80% by weight is filler and from about 80% to about 20% is acrylic binder. In a preferred embodiment, the coating comprises about 50% filler and about 50% binder. The filler is preferably about 65% clay, 26% decabromodiphenyloxide, and 9% antimony trioxide. The substrate is preferably comprised of about 75% by dry weight Owens-Corning H Glass ½" and 25% by dry weight Evanite 719 Glass Microfiber. The substrate may also be, for example, a woven fabric of DE, E, H, or G filament available

from BFG Industries. The substrate is approximately 50% by weight of the fire resistant fabric material. The binder which bonds together the glass fibers is approximately 100% B. F. Goodrich 2679 Acrylic Latex, but binder components may also include Cymel 373, citric acid, Rohm & Haas GL-618 Latex and Borden FG-413F UF Resin.

The substrate may be coated by air spraying, dip coating, knife coating, roll coating or film application such as lamination/heat pressing. The coating may be bonded to the substrate by chemical bonding, mechanical bonding and/or thermal bonding. Mechanical bonding is achieved by force feeding the coating onto the substrate with a knife.

Fire resistant fabric materials made in accordance with this invention may be of any shape. Preferably, such articles are planar in shape. The fire resistant fabric materials may be used in any of a variety of products, including, but not limited to mattress/crib fabrics, mattress/crib covers, upholstered articles, bedroom articles, (including children's bedroom articles), draperies, carpets, wall coverings (including wallpaper) tents, awnings, fire shelters, sleeping bags, ironing board covers, fire resistant gloves, fire-resistant clothing for race car drivers, fire fighters, jet fighter pilots, and the like, building materials, such as roofing shingles, structural laminate facing sheets, building air duct liners, roofing underlayment (or roofing felt), underlayment for organic, built up roofing materials, roll roofing, modified roll products, filter media (including automotive filters), automotive hood liners, head liners, fire walls, vapor barriers etc.

The fire resistant fabric material may be used alone or may be used as a liner for a decorative fabric, such as the type used for mattresses, drapes, sleeping bags, etc. which may also be fire resistant.

The substrate may be coated on one side or both sides depending on the intended application. For instance, if one side of the substrate is coated with the filler/binder coating, the other surface can be coated with another material. In the roofing materials industry, for example, the other material may be conventional roofing asphalt, modified asphalts and non-asphaltic coatings, and the article can then be topped with roofing granules. It is believed that such roofing material could be lighter in weight, offer better fire resistance and better performance characteristics (such as cold weather flexibility, dimensional stability and strength) than prior art roofing materials.

Additionally, the fire resistant fabric material may be coated with a water repellent material or the water repellent material may be added in the coating (i.e., internal water proofing). Two such water repellent materials are Aurapel™ 330R and Aurapel™ 391 available from Sybron/Tanatex of Norwich, Conn. In addition, Omnova Sequapel™ and Sequapel 417 (available from Omnovasolutions, Inc. of Chester, S.C.); BS-1306, BS-15 and BS-29A (available from Wacker of Adrian, Mich.); Syl-off™-7922, Syl-off™-1171A, Syl-off™-7910 and Dow Corning 346 Emulsion (available from Dow Corning, Corporation of Midland, Mich.); Freepel™-1225 (available from BFG Industries of Charlotte, N.C.); and Michem™ Emulsion-41740 and Michem™ Emulsion-03230 (available from Michelman, Inc. of Cincinnati, Ohio) may also be used. It is believed that wax emulsions, oil emulsions, silicone emulsions, polyolefin emulsions and sulfonyls as well as other similar performing products may also be suitable water repellent materials.

A defoamer may also be added to the coating of the present invention to reduce and/or eliminate foaming during production. One such defoamer is Drew Plus Y-250 available from Drews Industrial Division of Boonton, N.J. In addition, ionic materials may be added to increase the ionic charge of the coating, such as ammonium hydroxide, Natrosol-HEC™ available from Hercules of Wilmington, Del.) and ASE-95NP and ASE-60 (available from Rohm & Haas of Charlotte, N.C).

Further, fire resistant fabric materials made in accordance with the invention may be coated with an algaecide such as zinc powder, copper oxide powder or the herbicides Atrazine available from e.g. Ribelin Industries or Diuron available from e.g. Olin Corporation, an antifungal material such as Micro-Chek™ 11P, an antibacterial material such as Micro-Chek™ 11-S-160, a surface friction agent such as Byk™-375, a flame retardant material such as ATH (aluminum trihydrate) available from e.g. Akzo Chemicals and antimony trioxide available from e.g. Laurel Industries. In addition, color pigments, including, but not limited to, T-113 (Abco, Inc.), W-4123 Blue Pigment, W2090 Orange Pigment, W7717 Black Pigment and W6013 Green Pigment, iron oxide red pigments (available from Engelhard of Louisville, Ky.) may also be added to the coating of the present invention to impart desired characteristics, such as a desired color. The Micro-Chek™ products are available from the Ferro Corporation of Walton Hills, Ohio Byk-375 may be obtained from Wacker Silicone Corporation of Adrian, Mich. and T-1133A is sold by Abco Enterprises Inc. of Allegan, Mich.

The additional coatings of, e.g. water repellent material, antifungal material, antibacterial material, etc., may be applied to one or both sides of fire resistant fabric materials otherwise having filler/binder coatings on one or both sides of the substrate. For example, fire resistant fabric materials comprising substrates coated on one or both sides with filler/binder coatings could be coated on one side with a water repellent composition and on the other side with an antibacterial agent. Alternatively, the water repellant material, antifungal material, antibacterial material, etc., may be added to the coating before it is used to coat the substrate.

Foamed fire resistant fabric materials made in accordance with the present invention may be made by any of the known methods for making foamed compositions such as, for example, aeration by mechanical mixing and the other techniques described in U.S. Pat. No. 5,110,839.

EXAMPLE I

To produce the fire resistant fabric materials of the present invention, the applicant formulated the coating using just three major components, water, filler and binder (see Table I above). The amounts of the major constituents were as follows: approximately 28% water, 25% Hycar 2679, and 23% clay (dry percentages are 0%, 23% and 42% respectively). Additional filler materials, decabromodiphenyloxide (approximately 9% of the wet formula weight and 16% of the dry formula weight) and antimony trioxide (approximately 3% of the wet formula weight and 5.6% of the dry formula weight) were also added. The binders Cymel 373 (approximately 3.7% wet/5,9% dry) and Rhoplex TR-407 (approximately 4.5% wet and 3.8% dry) were also used. In total, the binder and filler made up 59.6% wet and 47.10% dry of the total coating. Dye and defoaming agent made up less than 1% of the dry formulation, water repellant made up less than 2% of the dry formulation, ionic material (ammonium hydroxide) made up less than 1% of the dry formulation and defoaming agent made up less than 0.2% of the dry formulation. The defoaming agent was Drew Plus Y-250. The materials were mixed in a reaction or mixing kettle for 45 minutes.

The coating was used to coat a fiberglass mat on one and both sides. The mat was manufactured by Elk Corporation of

Ennis, Tex. and had a basis weight in the range of 1.4 lb./sq. to 2.0 lb./sq. The mat had a porosity in the range of 800 to 1,000 cfm/ft^2. Generally, when such highly porous mats have been coated on one side only, the coating bleeds through to the other side. In accordance with the present invention however, the novel coating comprising clay coated the surface of the fiberglass mat very well and did not bleed through to the other side of the mat. The coated article was durable and flexible and did not crack on bending. Typical tensile strength measurements for uncoated versus coated were 75 lbs/3" and 217 lbs/3" respectively. Typical Elmendorff tear strength measurements were ≧3200 grams without the sample tearing.

The fire resistant fabric material was checked for combustibility. When exposed to the flame of a Bunsen Burner from a distance of two inches, woven fabric and wet lay fabric failed the fire test (i.e. the glass fiber melted or a hole was created where the flame hit the fabric). However, when the fire resistant fabric material of the present invention was exposed to the flame of a Bunsen Burner from a distance of two inches for a period of five minutes or more, no hole was created and the glass fibers did not melt. The coating protected the glass fabric from melting or disintegrating and the integrity of the glass fabric structure was maintained. The Technical Bulletin 129 of the State of California Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation (October 1992) indicates that a fabric should maintain integrity when exposed to an open flame for 20 minutes and that test was passed in the lab with the present invention.

Surprisingly, when the coating of the present invention was used to coat the fiberglass mat on one side, it did not bleed through to the other side even though the coating had a relatively low viscosity of approximately 1000 cp. Although not wishing to be bound by any particular theory, the applicant believes that the coating did not bleed through the mat because the fiberglass mat is anionic and the coating of the present invention (when wet) includes a combination of water and Hycar 2679 (which together are anionic) and clay filler (which is made anionic by the presence of antimony trioxide). The addition of the ammonium hydroxide increased the anionic charge of the coating. The resultant formulation had a low viscosity believed to be due to the repulsion of charges of the anionic latex in water and the anionic clay/ammonium hydroxide. Although low viscosity is not a desired objective for coating a highly porous mat, the unique characteristic of the invention is that the coating does not bleed through regardless of the viscosity because the mat is also anionic and like charges repel each other just as the north pole of one magnet repels the north pole of another magnetic.

If desired, however, the viscosity of the coating can be increased through mixing. The water and latex solution to which filler and ammonium hydroxide were added is acidic in nature and, on prolonged mixing, there is some hydrolysis thereby increasing the viscosity of the coating. The longer or the more rapidly the coating is mixed, the higher the viscosity. However, the coating still maintains an essentially anionic charge and thus there is still repelling of charges between the coating and the substrate.

Whether slowly or rapidly mixed, the coatings of the present invention may be applied to the substrates in relatively uniform thin coats because the like charges among the filler and acrylic latex elements in the coating repel one another. Thus, it is believed that the ionic charge repulsion characteristic which prevents the coating from bleeding through the mat also enables the application on the mat of a relatively uniform thin film coating. In instances where, due to price, supply or other considerations, the filler material to be employed has an ionic charge which is essentially the opposite of the charge of the substrate, modifiers are available to coat the filler material so that ultimately the coating and substrate of the article have essentially the same ionic charge. It is believed that viscosity modifiers could serve such a purpose.

The invention provides a fire resistant fabric material which is flexible, pliable has good drapability characteristics and which shows no signs of cracking, etc. The coated fabric has a porosity of less than 10.4 cfm (uncoated has a porosity of 440 cfm) and adheres very well to other materials, including decorative fabrics, polyurethane foam, isocyanurate foam, asphaltic compounds, and granules (non-asphaltic shingle components).

The coated product may have few pinholes or may have numerous pinholes and still maintain a porosity of less than from approximately 5 to approximately 50 cfm when coated with solvent based adhesive such as Firestone Bonding Adhesive BA-2004 which does not bleed through the coated product.

The fire resistant fabric materials were made water repellent by adding to the coating the water repellent materials listed above. The application of the coating to the substrate was accomplished by diluting the coating compound with water and then kiss coating the articles on one side while they were being coated on the other side by standard coating techniques which included the use of a doctor blade. The coating may also be performed by dip coating, scraping with a blade, or squeezing between two rolls having a gap that determines the thickness of the coating.

Prior to coating with a water repellent coating, the novel coating of the present invention can be treated with pigment or dye or any other suitable coloring means to give color to the fire resistant fabric materials of the invention. For instance, a W-4123 Blue Pigment (available from Engelhard of Louisville, Ky.) (0.5% by wet weight) was added to the coating composition to give color texture to the finished coating on the fiberglass mat.

Besides water repellent treatment, the fire resistant fabric materials of the present invention can be coated with antifungal, antibacterial and surface friction agents, an algaecide and/or a flame retardant material by mixing with the coating constituents prior to coating the substrate or by spraying on the partly finished articles at some point in the processing, e.g. between drying and curing.

Coating of the fiberglass substrates was accomplished using a hand-held coater which can be obtained from the Gardner Company, but any conventional method, such as spraying, dipping and flow coating from aqueous or solvent dispersion, calendering, laminating and the like, followed by drying and baking, may be employed to coat the substrate as is well known in the art. Best coating results were observed using a Gardner profile 10 blade. After coating, the samples were placed in an oven at approximately 400° for about 2.0 minutes to achieve drying and curing. Additionally, the coating may be separately formed as a film of one or more layers for subsequent combination with the substrate.

Hycar™ 2679 acrylic latex polymer has a low Brookfield viscosity of 100 cP. The low viscosity makes the polymer easily miscible with water and filler. This heat reactive acrylic polymer is compatible with all fillers due to its anionic charge. Products made with coatings which include the polymer are flexible at extreme high and low temperatures because the polymer has a glass transition temperature (Tg) of −3 C.

Hycar™ 2679 polymer emulsion contains a colloidal dispersion of polymer and copolymers in water, emulsifiers, such as synthetic soap (sometimes known as surface active agents or surfactants) and other ingredients such as buffers and protective colloids. These ingredients enable the polymer to be compatible with a wide variety of fillers. Without being bound to any particular theory, it is believed that Hycar™ 2679, with its thixotropic characteristics, enhances the viscosity of most fillers.

It is believed that a preferred embodiment is prepared by combining constituents in the following wet amounts: 27.47% water, 25% Hycar™ 2679 acrylic latex, 3.7% Cymel™ 373, 4.5% RHOPLEX™ TR-407, 22.6% mattress grade clay, 3% antimony trioxide, 9% decabromodiphenyloxide, 0.05% Natrosol™ HEC, 2.5% Aurapel™-391, 0.5% Acrysol™ ASE-95NP, 1.13% ammonium hydroxide, 0.1% Y-250 defoamer and 0.5% W4123 Blue Pigment.

It should be understood that the above examples are illustrative, and that compositions other than those described above can be used while utilizing the principals underlying the present invention. For example, other sources of filler as well as mixtures of acrylic latex and/or surfactants can be used in formulating the fire resistant fabric materials of the present invention. Moreover, the coating compositions can be applied to various types of substrates, as described above.

What is claimed is:

1. A fire resistant fabric material comprising a substrate having an ionic charge coated with a coating having essentially the same ionic charge,

wherein said coating consists essentially of a filler material comprising clay and a binder material,

wherein said binder material bonds the filler material together and to the substrate,

wherein said coating does not bleed through said substrate, and

wherein said fire resistant fabric material is dranable and has a porosity of between 5 and 50 cfm.

2. The fire resistant fabric material according to claim 1 wherein said substrate is fiberglass, said filler further comprises at least one other filler selected from the group consisting of decabromodiphenyloxide, antimony trioxide, fly ash, charged calcium carbonate, mica, glass microspheres and ceramic microspheres and said binder is acrylic latex.

3. The fire resistant fabric material according to claim 2 wherein said substrate is planar and is coated on one side with said coating.

4. The fire resistant fabric material according to claim 2 wherein said substrate is planar and is coated on both sides with said coating.

5. The fire resistant fabric material according to claims 1, 3 or 4, wherein said material further includes on one or both sides a water repellent material.

6. The fire resistant fabric material according to claims 1, 3 or 4 wherein said material further includes on one or both sides an antifungal material.

7. The fire resistant fabric material according to claims 1, 3 or 4 wherein said material further includes on one or both sides an antibacterial material.

8. A fire resistant fabric material according to claims 1, 3 or 4 wherein said material further includes on one or both sides a surface friction agent.

9. A fire resistant fabric material according to claims 1, 3 or 4 wherein said material further includes on one or both sides a flame retardant material.

10. A fire resistant fabric material according to claims 1, 3 or 4 wherein said material further includes on one or both sides an algaecide.

11. A fire resistant fabric material according to claims 1, 3 or 4 wherein said material is colored with dye.

12. A fire resistant fabric material comprising a substrate coated with a coating consisting essentially of a filler material comprising clay and a binder material wherein

(a) said substrate comprises glass fibers and wherein said material is from 65% to 90% by weight of the glass fibers;

(b) said coating is from 20% to 80% wet weight of filler and from 80% to 20% wet weight of acrylic latex binder material, and

(c) said fire resistant fabric material is drapable and has a porosity of between 5 and 50 cfm.

13. The fire resistant fabric material according to claim 12 wherein said filler further comprises at least one filler selected from the group consisting of decabromodiphenyloxide, antimony trioxide, mica, fly ash, charged calcium carbonate, glass inicrospheres and ceramic microspheres.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,858,550 B2
APPLICATION NO. : 09/955395
DATED : February 22, 2005
INVENTOR(S) : Ahluwalia

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Claim 1, col. 11, line 37:

"dranable," should read --drapable--

Claim 13, col. 12, line 42:

"inicrospheres" should read --microspheres--

Signed and Sealed this

Nineteenth Day of September, 2006

Jon W. Dudas

JON W. DUDAS
Director of the United States Patent and Trademark Office

Exhibit 2

United States Patent [19]

Blanpied

[11] **Patent Number:** **5,001,005**

[45] **Date of Patent:** **Mar. 19, 1991**

[54] **STRUCTURAL LAMINATES MADE WITH NOVEL FACING SHEETS**

[75] Inventor: **Robert H. Blanpied**, Meridian, Miss.

[73] Assignee: **Atlas Roofing Corporation**, Meridian, Miss.

[21] Appl. No.: **568,705**

[22] Filed: **Aug. 17, 1990**

[51] **Int. Cl.**^{5} **B32B 3/26**

[52] **U.S. Cl.** **428/283**; 428/285; 428/304.4; 428/319.1; 428/323; 428/324; 428/326; 428/328

[58] **Field of Search** 428/283, 285, 304.4, 428/319.1, 323, 324, 326, 328

[56] **References Cited**

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Primary Examiner—William J. Van Balen
Attorney, Agent, or Firm—Branigan & Butler Griffin

[57] **ABSTRACT**

A structural laminate comprises at least one planar facing sheet comprised largely of glass fibers but not having micro-glass as a filler. The facing sheet is self adhered to a rigid thermosetting plastic foam core. The non-glass filler material is chosen from a group consisting of clay, mica, talc, limestone (calcium carbonate), gypsum (calcium sulfate), aluminum trihydrate (ATH), antimony oxide, cellulose fibers, and plastic polymer fibers. The non-glass filler material improves containment of liquid plastic thermosetting polymer, and offers economic and safety advantages.

7 Claims, No Drawings

STRUCTURAL LAMINATES MADE WITH NOVEL FACING SHEETS

BACKGROUND

1. Field of Invention

This invention relates to laminates and foam filled panel products which are rigid and reasonably strong, and more particularly relates to structurally rigid boards of foam which have at least one planar flat side covered with a facing sheet.

2. Prior Art and Other Considerations

The field of foamed core laminated panels is large and well known in commerce. Over the years, flat rigid sheets and continuous webbed flexible sheets have been used to provide one or both facings ("facers") for a foamed core panel.

The facer sheets have been formed of paper, plastic, aluminum foil, other metals, rubber, wood, and even vegetable based skins. These facer sheets contain cellular plastic foam between two facers in parallel planes in a panel, and form a laminated "sandwich board" configuration.

One of the most successful facer panels has been made using a mat of 100% glass fibers. The glass fibers are bonded together with resin binders to form opposing facers for containing or sandwiching thermosetting plastic foam therebetween.

Another prior art practice has been to pre-attach fiberglass mat or skrim with paper, or plastic, or aluminum foil, or a combination of any two or three.

Glass mats have been saturated with asphaltic materials to form facers of reduced porosity. Multi-layered, pre-assembled, facing sheets of myriad components have also been employed by producers of structural foam core laminate panels.

For many years now, glass fibers having a diameter of 10 microns or less and usually less than 0.5 inches in length, called "micro-fibers" or "fibrous glass dust", have functioned as fillers in the production of glass fiber mats. The function of a "filler" in the manufacture of glass fiber mat sheets, is to decrease the porosity of the fibrous sheet. If the glass fiber sheet has a high porosity, it cannot be used as a facing sheet for thermosetting plastic foams, because the liquid polymer will not be contained by a porous glass fiber mat (sheet). Consequently, the makers of glass fibrous mats have resorted either to a multi-layered facer or to the use of micro-fibers as their best means to accomplish the necessary low porosity of their glass mat so it can be used as a facing material for thermosetting plastic foam laminated panels.

One major problem always confronting the panel users, and thus the producers, of foam core panels has been the safety factor. In recent years, scientists have classified "micro-fibers" as a serious hazard to human safety. These, short, thin glass fibers may ultimately be classified as a human carcinogen. In 1990, The American Conference of Governmental Industrial Hygienists (ACGIH) listed the Threshold Limit Value (TLV) of Fibrous Glass Dust to have a maximum Time Weighted Average (TWA) exposure of only 10 milligrams per cubic meter.

An additional area of safety hazard has been the combustibility of foam core laminated panels, especially when asphalt, plastic or cellulose are employed in making the facing sheets. Both metal facing sheets and glass fiber facing sheets offer some measure of fire safety, but both types have been quite expensive. The addition of hazardous glass micro-fibers has also added to the cost of glass fiber facing sheets.

Accordingly, it is an object of the present invention to provide a foam core laminated structural panel having safe and economical facers.

An advantage of the present invention is the provision of foam core laminated structural panels having relatively non-combustible facers.

Another advantage of the present invention is the provision of foam core laminated structural panels having facers which lack micro-fibers.

Yet another advantage of the present invention is the provision of a reduced porosity, predominately glass fiber facing sheet, devoid of micro-fibers or fibrous glass dust, and which prevents the penetration of liquid polymeric plastic foam mixtures.

Another advantage of the present invention is the provision of foam core laminated structural panels having facers which are smoother to the touch than a 100% glass mat.

Yet another advantage of the present invention is the provision of foam core laminated structural panels having facers which are economical and yet which combat combustibility and porosity while improving surface texture.

SUMMARY

Thermosetting plastic foam laminates of the invention comprise at least one planar facing sheet and a rigid foam integrally attached upon formation of the foam to a surface of a facing sheet. The rigid foam is formed from any thermosetting catalyzed plastic reaction product capable of being foamed.

The planar facing sheets includes (A) from 60% to 90% by weight glass fibers exclusive of glass micro-fibers, and (B) from 10% to 40% by weight non-glass filler material, and (C) from 1% to 30% by weight non-asphaltic binder material which bonds the fibers together and bonds the filler materials to the fibers.

The non-glass filler material is chosen from a group consisting of clay, mica, talc, limestone (calcium carbonate), gypsum (calcium sulfate), aluminum trihydrate (ATH), antimony oxide, cellulose fibers, and plastic polymer fibers. The non-glass filler material improves retention of liquid plastic thermosetting polymer, and offers economic and safety advantages.

DESCRIPTION OF THE INVENTION

All thermosetting foams of the present invention are all those plastic resins which can be blown into a cellular, foamed structure by any known blowing agent, and which become rigid solids by catalyzed reaction. All structural laminates of the present invention have a thermosetting plastic foam between two facers, at least one of which is a facer of the present invention. All embodiments of the facers of the present invention have ordinary glass fibers as their major component with an amount of a non-glass filler material making up between about 10% and about 40% of the total weight of the facer sheet. The filler materials of this invention are: clay, mica, talc, limestone (calcium carbonate), gypsum (calcium sulfate), aluminum trihydrate (ATH), antimony oxide, cellulose fibers, plastic polymer fibers, or a combination of any two or more of these substances, and are collectively and individually referred to herein as "fillers" or "filler materials". The term, "aluminum

trihydrate", is a contraction of dried "aluminum trihydroxide", $Al(OH)_3$.

The fillers of this invention can be added to the mat either with the furnish going to a headbox of a forming machine, or they can be added to the binder resin which is usually applied via an on-line curtain coater, or they can be added to the glass mat in a subsequent operation after it is dried and wound up in rolls.

If used before the mat is dried and wound up in rolls, the filler materials of the present invention are bonded to the glass fibers either by binders such as urea-, phenol-, or melamine-formaldehyde resins (UF, PF, and MF resins), or a modified acrylic or polyester resin. If added in a subsequent operation, polymer latexes are used with or without dye coloring. The ordinary polymer latexes of this invention are, but are not limited to: Styrene-Butadiene-Rubber (SBR), Ethylene-Vinyl-Chloride (EVCl), PolyVinylidene Chloride (PVdC), modified PolyVinyl Chloride (PVC), PolyVinyl Alcohol (PVOH), and PolyVinyl Acetate (PVA). No asphalt is used as a binder in this invention.

Many, but not all, of the glass fiber mats of this invention are wet-formed into a continuous non-woven web of any workable width on a Fourdrinier machine. Preferably, an inclined wire such as Sandy Hill's "Delta Former" is used. These machines usually use a curtain coater prior to the dryer section to add the binder resin.

Facer Example No. 1

In the process of making a glass fiber mat, the furnish is made by eliminating the micro-fibers, and in their place substituting a cellulose fiber. The weight percent of cellulose fibers as a percent of all fibers is at least 10 percent. The fibers are bonded together by an ordinary prior art non-asphaltic binder resin referred to above.

Facer Example No. 2

In the process of making a glass mat for glass shingles, the glass fiber furnish is already without the hazardous micro-fibers. This "shingle mat" is suitable for being coated, or saturated, with asphalt type coatings/saturants, but it is not suitable as a facer for thermosetting plastic foam. The porosity of a shingle mat is too high to contain the liquid phase of any thermosetting plastic resin. The liquid resin which penetrates the porous shingle mat causes malfunction of the foam laminate processing equipment, shutting it down. Such a mat can be modified in a subsequent process to considerably reduce the liquid porosity of the mat. For example, a shingle mat is coated with a coating consisting of (dry solids basis), 90% limestone and 10% polymer latex. Any thermoplastic polymer latex can be used. A suitable coating is made by mixing one of these latex emulsions with water, a 325 mesh limestone, and a suitable thickener such as methyl ethyl cellulose (MEC) to a workable coating viscosity. A good range of coating viscosities is from 500 to 4000 cps (Brookfield @ RT).

Facer Example No. 3

Any one of the thermoplastic polymer latexes mentioned above is mixed with clay, talc, mica, or other mineral pigment filler, in ratios of from about 3-to-1 up to about 12-to-1 (dry solids basis of filler to binder), with additional water and a water thickener such as MEC, to form a suitable coating which reduces the porosity of shingle mat to the extent it can be used as a facer for thermosetting plastic foam boards.

Facer Example No. 4

In the glass web forming process of Facer Example No. 1, the cellulose fibers are eliminated and thermoplastic fibers are substituted therefor. Examples of such fibers are polyester, polyacrylic, nylon, polyethylene, polypropylene, and the like. Similar resin binders can be used, such as modified acrylic, modified polyester, UF, PF, or MF.

Facer Example No. 5

In the glass web forming process of Facer Example No. 2, the micro-fibers are left out, no additional fibers are added, and the resin binder does not have pigment filler. However, a glass mat with mineral pigment filler added to the resin binder can be made which reduces the porosity of the mat to an extent that it can be successfully used as a facer to a thermosetting plastic foam laminate. For example, a common urea-formaldehyde binder resin is mixed with talc, clay, mica, limestone, or ATH to form a thick binder which reduces the porosity of a glass mat not made with glass micro-fibers, cellulose fiber, or plastic fiber fillers.

Facer Example No. 6

In the glass web forming process of Facer Example No. 5, no fiber is used in the resin binder mix. However, a glass mat is made using fibers of cellulose or plastic mixed into the binder, which is generally added by a curtain coater. The fiber-binder resin mixture reduces the porosity of the glass web such that it makes a suitable facer for foam laminates.

Facer Example No. 7

A glass web is made using both mineral pigment fillers (exclusive of gypsum) and fibers of cellulose or plastic mixed with the binder resin applied at the curtain coater. Appropriate mixtures of fibers with pigments and with the thermosetting resin binders referred to above are made which are particularly cost effective in reducing the porosity of the predominately glass mat.

Facer Example No. 8

A glass web is made where the mineral pigment filler(s), as well as the cellulose or plastic fiber filler(s) are added to the stock coming to the headbox of the forming machine. The binder resin application at the curtain coater is either without any filler in it, or else it contains one or more of the fillers used in the present invention. Such a glass mat is made with sufficiently low porosity to be used as a facer for a thermosetting foam.

THERMOSETTING FOAM LAMINATES

All thermosetting plastic foam laminates of the present invention have at least one facing sheet made by the foregoing facer examples. Any prior art phenol-formaldehyde, polyurethane, or polyurethane modified polyisocyanurate foam can be used with one, or more, facers of the present invention to make a structural laminate of the instant invention. If such a structural laminate has only one facer of the present invention, the facer on the opposite broad face of the laminate can be any prior art facer. Examples of such prior art facers are: pure aluminum foil, multi-laminated sheets of foil-Kraft-foil or just one foil layer on Kraft paper, 100% glass fiber mat, aluminum foil glued to 100% glass fiber mat, cellulose felt, glass fiber modified cellulose felt, or asphalt coated glass mat.

It is obvious to one skilled in the art, that literally dozens of examples of suitable combinations of two similar facers of the present invention with various thermosetting foams can be made. Likewise, it is obvious that two dissimilar facers of the present invention can be used to make even more combinations of examples of suitable foam laminates of the instant invention. Furthermore, the skilled designer of such board laminates could conceive of literally thousands of combinations using just one facer of the present invention with a variety of thermosetting plastic foam formulae, and with a variety of just one prior art facer.

While the invention has been particularly shown and described with reference to the preferred embodiments thereof, it will be understood by those skilled in the art that various alterations in form and detail may be made therein without departing from the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A thermosetting plastic foam laminate comprising:
(1) at least one planar facing sheet comprising:
  (A) from 60% to 90% by weight glass fibers exclusive of glass micro-fibers, and
  (B) from 10% to 40% by weight non-glass filler material, and
  (C) from 1% to 30% by weight non-asphaltic binder material which bonds the fibers together and bonds the filler materials to the fibers;
(2) a rigid foam integrally attached upon formation of the foam to the surface of a facing sheet, the rigid foam formed from a thermosetting catalyzed plastic reaction product capable of being foamed.

2. The thermosetting plastic foam laminate of claim 1 wherein there are two parallel facing sheets of the same composition.

3. The thermosetting plastic foam laminate of claim 1 wherein said non-glass filler material is chosen from a group consisting of clay, mica, talc, limestone (calcium carbonate), gypsum (calcium sulfate), aluminum trihydrate (ATH), antimony oxide, cellulose fibers, and plastic polymer fibers.

4. A method of making a thermosetting plastic foam laminate, said method comprising:
binding a non-glass filler material to a mat of glass fibers which does not contain glass micro-fibers to form a planar facing sheet, whereby said planar facing sheet comprises from 60% to 90% by weight glass fibers and from 10% to 40% by weight non-glass filler material;
attaching a rigid foam formed from a thermosetting catalyzed plastic reaction product capable of being foamed to said planar facing sheet upon formation of the foam.

5. The method of claim 4, wherein two parallel facing sheets of the same composition are attached to said rigid foam.

6. The method of 4, wherein said non-glass filler material is chosen from a group consisting of clay, mica, talc, limestone (calcium carbonate), gypsum (calcium sulfate), aluminum trihydrate (ATH), antimony oxide, cellulose fibers, and plastic polymer fibers.

7. The method of claim 6, wherein said binding is accomplished using from 1% to 30% by weight non-asphaltic binder material which bonds the fibers together and bonds the filler materials to the fibers.

* * * * *

Exhibit 3

US006586353B1

(12) **United States Patent**
Kiik et al.

(10) **Patent No.: US 6,586,353 B1**
(45) **Date of Patent: *Jul. 1, 2003**

(54) ROOFING UNDERLAYMENT

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 135 days.

This patent is subject to a terminal disclaimer.

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(58) **Field of Search** 442/320, 64, 65, 442/68, 136, 172; 428/141, 489, 357, 323, 105, 317.7

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Product description for Tough–Guard® Roof Eave and Valley Protector reprinted from the Georgia–Pacific Web site, the URL of which is http://www.gp.com/roofing/pdf/041700.pdf.

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(57) **ABSTRACT**

The present invention relates to a roofing underlayment system comprising two layers of a coated structural article which comprises a substrate having an ionic charge coated with a coating having essentially the same ionic charge or one layer of such coated structural article in combination with one layer of felt material. The coating of the coated structural article consists essentially of a filler material and a binder material wherein the binder material bonds the filler material together and to the substrate and wherein the coating does not bleed through the substrate. The roofing underlayment system of the present invention can impart a Class B or better (Class A) fire rating to a roof assembly.

18 Claims, No Drawings

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ROOFING UNDERLAYMENT

The applicants claim the benefits under Title 35 U.S.C. §119(e) of prior U.S. Provisional Application Serial No. 60/168,057 which was filed on Nov. 30, 1999.

FIELD OF THE INVENTION

This invention relates to a roofing underlayment system useful in roof assemblies comprising at least two layers of a coated structural article which comprises a substrate having an ionic charge coated with a coating having essentially the same ionic charge, or at least one layer of such coated structural article in combination with at least one layer of felt material. The underlayment of the present invention allows roof assemblies to achieve a class B or better (Class A) rating for protection against moderate to severe exposure to fire.

BACKGROUND OF THE INVENTION

Roofing underlayment is applied to the deck of a roof before the application of roofing shingles or other roofing material primarily to shield the roof deck from moisture, both during assembly and after roof installation. Underlayment also helps reduce "picture framing" in which the outline of deck panels caused by irregularities in the deck surface may be visible through the roofing material applied to the roof deck. Further, the roofing underlayment should be a key component of a fire rated roof assembly. The underlayment structure should assist in preventing flaming of the underside of the deck when exposed to fire on top of the roof covering assembly. Thus, the benefits of the underlayment in the roof assembly are to provide additional fire resistance and water resistance, and to provide uniformity of the appearance of the roof surface.

Conventional roofing underlayment typically comprises a dry cellulosic felt that can be impregnated or saturated with an organic material such as asphalt. When used as an underlayment, felt typically does not provide a completely flat surface, but has undulations and distortions. It may also distort under high moisture conditions. Saturated organic felt underlayment has poor fire resistance and when burned, disintegrates.

There has long been a need for roofing underlayment that will protect a roof deck from flaming, even when noncombustible roofing materials are employed as the visible roof covering. For instance, metal roofing materials, either standing seam or shingles, are typically considered noncombustible materials. However, for noncombustible metal roof coverings to achieve a Class A fire resistance rating, a ½ inch layer of gypsum board or a layer of ¼ inch Dens-Deck board is usually required on top of the roof deck beneath the saturated felt underlayment that is under the metal roof covering. That is because the heat of a fire burning on top of roofing materials, including noncombustible metal roof coverings, passes through the material to the underlayment which is then susceptible to burning and disintegration. Thus, it has heretofore been deemed necessary to place gypsum board or Dens-Deck board on a roof deck beneath felt underlayment and noncombustible metal roofing materials, even though such boards raise the cost of the roofing materials and their application, and despite the facts that they are heavy, difficult to handle, require covering to protect from rain, and are slippery on steep slopes; because otherwise, a Class A fire resistance rating cannot be achieved.

Thus, there is a need for a roofing underlayment system which provides fire resistance (preferably Class B or better), water resistance, and uniformity of the appearance of the roof surface, but which is not heavy, difficult to handle, slippery nor overly costly.

SUMMARY OF THE INVENTION

The present invention provides an improved roofing underlayment system comprising at least two layers of a coated structural article which comprises a substrate having an ionic charge coated with a coating having essentially the same ionic charge, or at least one layer of such coated structural article in combination with at least one layer of felt material. The felt material may be comprised of cellulosic fibers, glass fibers or mixtures thereof. In addition, the felt material may be saturated with an organic material, such as asphalt. The coating of the coated structural article consists essentially of a filler material and a binder material wherein the binder material bonds the filler material together and to the substrate and wherein the coating does not bleed through the substrate.

The roofing underlayment system of the present invention allows roof assemblies to achieve a Class B or better (Class A) rating for protection against moderate to severe exposure to fire without the use of intermediate barriers such as gypsum or other noncombustible decking. In addition, the roofing underlayment system of the present invention is not difficult to handle since it is lighter in weight than other roofing underlayment systems, is not slippery on steep slopes and is not as costly as other roofing underlayment systems comprising intermediate barriers.

The roofing underlayment system of the present invention may be used with a variety of roof assemblies including, but not limited to, combustible products and noncombustible products that do not meet a Class B or better fire resistance rating. Nonlimiting examples of such roof assemblies include, Class C asphalt shingles, plastic molded or extruded shingles, non-asphalt composite shingles, rubber based shingles, steel shingles, steel standing seam roofing systems, steel corrugated panel roofing systems, aluminum standing steam roofing systems, aluminum shingles, clay tiles, light weight concrete roofing shingles and cement tiles.

DETAILED DESCRIPTION

The applicants have discovered that an improved roofing underlayment system can be made by combining at least two layers of a coated structural article which comprises a substrate having an ionic charge coated with a coating having essentially the same ionic charge, or at least one layer of such coated structural article with at least one layer of a felt material.

Examples of suitable felt material include cellulosic fibers, glass fibers and mixtures thereof. The felt material may be saturated with an organic material, such as asphalt. Examples of such materials are disclosed in U.S. Pat. Nos. 4,513,045, and 5,717,012. The texts of both of these patents are incorporated herein by reference.

The coating of the structural article consists essentially of a filler material and a binder material. For example, U.S. Pat. No. 5,965,257, the text of which is incorporated herein by reference, teaches that by coating the substrate with a coating having essentially the same ionic charge, a zero bleed through product is made while using only two major ingredients in the coating. By producing a coating having essentially the same ionic charge as the substrate, a zero bleed through product may be produced having a low binder content and no viscosity modifiers.

The substrate of the structural article may be any suitable reinforcement material capable of withstanding high tem-

peratures such as glass fibers, polyester fibers, cellulosic fibers, asbestos, steel fibers, alumina fibers, ceramic fibers, nylon fibers, graphite fibers, wool fibers, boron fibers, carbon fibers, jute fibers, polyolefin fibers, polystyrene fibers, acrylic fibers, phenol-formaldehyde resin fibers, aromatic and aliphatic polyamide fibers, polyacrylamide fibers, or mixtures thereof which may include bi-component fibers or multi-component fibers.

In a preferred embodiment, the filler employed in the coating of the structural article may be class F fly ash, class C fly ash or mixtures thereof. Preferably, the filler is class F fly ash wherein 90% to 95% by weight of the fly ash is aluminosilicate. Such a fly ash, known as Alsil O4TR, is produced by JTM Industries, of Kennesaw, Ga. In an alternative embodiment, the filler may be charged calcium carbonate or ceramic microspheres, or a blend of fly ash and calcium carbonate, or a blend of fly ash, calcium carbonate and ceramic microspheres.

The table below provides, in percentages, some of the combinations of calcium carbonate, fly ash and ceramic microspheres which may be utilized as the filler component in the coating:

TABLE I

	A %	B %	C %	D %	E %	F %
1. Water	18.9	25.9	37.33	25.9	24.9	24.9
2. Acrylic Latex	6.0	6.0	6.42	6.0	6.0	6.0
3. Fly Ash	75.0	34.0	—	40.0	—	20.0
4. $CaCO_3$	—	34.0	—	—	40.0	20.0
5. Microspheres	—	—	56.14	28.0	29.0	29.0
6. Defoamer	0.1	0.1	0.1	0.1	0.1	0.1
	100%	100%	100%	100%	100%	100%

The microspheres may be a 50/50 ratio of 3M's W1012 microspheres and 3M's smaller diameter G200 microspheres. Although the table shows possible combinations of calcium carbonate, fly ash and ceramic microspheres in the filler component of the coating, it is believed that any combination of these materials may be employed.

In one embodiment, the coating is prepared by using a binder material such as a high performance heat-reactive acrylic latex polymer to bond the filler materials together and to bond the filler to the substrate. Such a binder material is Hycar 2679 acrylic latex polymer supplied by B.F. Goodrich Company of Cleveland, Ohio. It is believed, however, that any linear polymer, linear copolymer or branched polymer may be useful in preparing the coating. Possible binder materials include butyl rubber latex, SBR latex, neoprene latex, polyvinyl alcohol emulsion, SBS latex, water based polyurethane emulsions and elastomers, vinyl chloride copolymers, nitrile rubbers and polyvinyl acetate copolymers.

In a preferred embodiment, the coating may comprise nearly 85% by weight of the structural article. In that coating, approximately from 84% to 96% by weight may be filler and the remainder may be the acrylic latex binder. The filler may be approximately 50% fly ash and 50% calcium carbonate. The substrate may comprise about 15% by weight of the structural article. Glass fibers may comprise approximately 12% by weight of the article and a binder material may comprise about 3% by weight of the article. The binder which bonds together the glass fibers may be from 99% to 75% (preferably 98% to 94%) by weight urea formaldehyde and from 1% to 25% (preferably 2% to. 6%) by weight standard acrylic latex.

The substrate may be coated in a variety of ways. For example, the substrate may be coated by air spraying, dip coating, knife coating, roll coating or film application such as lamination/heat pressing. The coating may be bonded to the substrate by chemical bonding, mechanical bonding and/or thermal bonding. Mechanical bonding may be achieved by force feeding the coating onto the substrate with a knife.

Structural articles made in accordance with this invention may be of any shape but preferably, such articles are planar in shape. The substrate is coated on one side or both sides depending on the intended application.

Additionally, the structural article may be coated with a water repellent material. Two such water repellent materials are Aurapel330R and Aurapel 391 available from the Auralux Corporation of Norwich, Conn. It is believed that wax emulsions, oil emulsions, silicone emulsions, polyolefin emulsions and surfonyls as well as other similar performing products may also be suitable water repellent materials. Further, structural articles made in accordance with the invention may be coated with an algaecide such as zinc powder, copper oxide powder or the herbicides Atrazine available from e.g. Ribelin Industries or Diuron available from e.g. Olin Corporation, an antifungal material such as Micro-Chek 11P, an antibacterial material such as Micro-Chek 11-S-160, a surface friction agent such as Byk-375, a flame retardant material such as ATH (aluminum trihydrate) available from e.g. AkzoChemicals and antimony oxide available from e.g. Laurel Industries and/or a coloring dye such as T-1133A and iron oxide red pigments, and other products which can impart specific surface functions. The Micro-Chek products are available from the FerroCorporation of Walton Hills, Ohio. Byk-375 may be obtained from Wacker Silicone Corporation of Adrian, Mich. and T-1133A is sold by Abco Enterprises Inc. of Allegan, Mich. The additional coatings of, e.g. water repellent material, antifungal material, antibacterial material, etc., may be applied to one or both sides of structural articles otherwise having filler/binder coatings on one or both sides of a substrate. For example, structural articles comprising substrates coated on one or both sides with filler/binder coatings could be coated on one side with a water repellent composition and on the other side with an antibacterial agent.

The substrate in the coating may be a nonwoven fiberglass mat which is desirable because it is light in weight. Fiberglass mats are also preferred as substrates because of their fire resistant nature, their resistance to moisture damage, their excellent dimensional stability, their resistance to curl with temperature changes, their resistance to rot and decay, and their ability to accept organic coatings.

As noted above, the felt material may be comprised of celluosic fibers, glass fibers or mixtures thereof, and may be asphalt saturated. In addition, other polyester or polypropylene reinforced matrixes utilized as roofing underlayments may be used. Examples of some of the various types of materials that could be used are disclosed in U.S. Pat. Nos. 4,513,045 and 5,717,012, the entire disclosures of which are incorporated herein by reference.

The applicants' invention allows roof assemblies to achieve a Class B or better (Class A) rating for protection against moderate to severe exposure to fire. This is because

in the applicants' underlayment system, the coated structural article is comprised mainly of nonflammable filler coating. Additionally, the mat which is coated by that filled coating is also nonflammable. Thus, the present invention provides a novel roofing underlayment system which is comprised of at least two layers of a coated structural article or at least one layer of such structural article combined with at least one layer of a felt material. The invention allows roofing assemblies to achieve Class A or B fire ratings without the use of intermediate barriers such as gypsum or other noncombustible decking.

In accordance with the invention, a roofing underlayment system is installed by combining at least two layers of the coated structural article or a first layer of a coated structural article adjacent to a second layer of a felt material. In a preferred embodiment, the coated structural article may be a coated fiberglass substrate made according to U.S. Pat. No. 5,965,257. In application to the roof deck, the composite underlayment may be applied with either component adjacent to the deck. Some unique, ornamental, highly combustible roofing products may require multiple layers of the coated structural article together with one layer of a felt material to achieve a Class A or B fire resistance rating.

The composite underlayment system of the present invention may be used with a variety of roof assemblies including, but not limited to, combustible products and noncombustible products that do not themselves meet a Class A or B fire resistance rating. Nonlimiting examples of combustible products which may be used with the composite underlayment system of the present invention include Class C asphalt shingles, plastic molded or extruded shingles, non-asphalt composite shingles and rubber based shingles. Nonlimiting examples of noncombustible products which may be used with the composite underlayment system of the present invention include steel shingles, steel standing seam roofing systems, steel corrugated panel roofing systems, aluminum standing seam roofing systems, aluminum shingles, clay tiles, light weight concrete roofing shingles and cement tiles.

The invention is further illustrated by reference to the following examples.

EXAMPLES

Burning Brand Tests

Class A burning brand tests were conducted at U.L. Laboratories with 30 gauge galvanized steel panels on 15/32 inch thick plywood decks. The following three configurations were tested: (1) two layers of VersaShield™ coated structural articles made in accordance with U.S. Pat. No. 5,965,257 and available from Elk Corporation in Ennis, Tex. were put between the deck and a steel panel; (2) one layer of VersaShield™ was put under one layer of D226 type II-felt underlayment available from Tamko Roofing Products in Jopplin, Mo. with a steel panel on top; and (3) one layer of VersaShield™ was put on top of one layer of D226 type II-felt underlayment with a steel panel on top. All three configurations passed the Class A burning brand tests. The preferred embodiment was one layer of VersaShield™ coated structural article combined with one layer of 30 lb. D226 type II-felt underlayment.

When a roofing underlayment comprising just one layer of the VersaShield™ coated structural article was tested between a deck and a steel panel, the configuration did not pass the Class A burning brand test. Similarly, when a roofing underlayment comprising just one layer of organic felt underlayment was placed between the deck and a steel panel, the configuration did not pass the Class A burning brand test.

It should be understood that the above examples are illustrative, and that compositions other than those described above can be used while utilizing the principals underlying the present invention. For example, other sources of inert materials as well as mixtures of binders and/or additives can be used in formulating the structural articles. Other suitable types of conventional underlayment can be used in combination with the coated structural article to improve the properties of the underlayment system formed therefrom.

What is claimed is:

1. A roofing underlayment system comprising at least one layer of felt material and at least one layer of a coated structural article, said structural article comprising a substrate having an ionic charge coated with a coating having essentially the same ionic charge wherein said coating consists essentially of a filler material and a binder material and wherein said binder material bonds the filler material together and to the substrate and wherein said coating does not bleed through said substrate.

2. The roofing underlayment system according to claim 1 wherein the felt material is selected from the group consisting of cellulosic fibers, glass fibers and mixtures thereof.

3. A roofing underlayment system comprising at least two layers of a coated structural article, said structural article comprising a substrate having an ionic charge coated with a coating having essentially the same ionic charge wherein said coating consists essentially of a filler material and a binder material and wherein said binder material bonds the filler material together and to the substrate and wherein said coating does not bleed through said substrate.

4. A roofing underlayment system according to claims 1 or 3 wherein said substrate is fiberglass, said filler is selected from the group consisting of fly ash, calcium carbonate, ceramic microspheres and mixtures thereof and said binder is acrylic latex.

5. A roofing underlayment system according to claim 4 wherein said substrate is planar and is coated on one side with said coating.

6. A roofing underlayment system according to claim 4 wherein said substrate is planar and is coated on both sides with said coating.

7. A roofing underlayment system according to claims 1 or 3 wherein said article further includes a water repellent material.

8. A roofing underlayment system according to claims 1 or 3 wherein said article further includes an antifungal material.

9. A roofing underlayment system according to claims 1 or 3 wherein said article further includes an antibacterial material.

10. A roofing underlayment system according to claims 1 or 3 wherein said article further includes a surface friction agent.

11. A roofing underlayment system according to claims 1 or 3 wherein said article further includes a flame retardant material.

12. A roofing underlayment system according to claims 1 or 3 wherein said article further includes an algaecide.

13. A roofing underlayment system according to claims 1 or 3 wherein said article is colored with dye.

14. A roofing underlayment system according to claims 1 or 3 wherein said substrate is bonded together by a binder material consisting essentially of urea formaldehyde and acrylic latex.

15. A roofing underlayment system according to claim 1 or 3 wherein the structural article is coated with a coating consisting essentially of a filler material and a binder material wherein

a) said article is from 10% to 25% by weight glass fibers and

b) said coating is from 84% to 96% filler selected from the group consisting of fly ash, charged calcium carbonate, ceramic microspheres and mixtures thereof and from 16% to 4% acrylic latex binder material.

16. A roofing underlayment system according to claim 15 wherein said coating further includes SBR rubber.

17. A roofing underlayment system according to claim 16 wherein said acrylic latex binder and said rubber are cross linked.

18. A roofing underlayment system according to claim 17 wherein said glass fibers are bonded together by a mixture of from 99% to 75% urea formaldehyde and from 1% to 25% acrylic latex.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,586,353 B1
DATED : July 1, 2003
INVENTOR(S) : Kiik et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 2,
Line 39, "steam" should read -- seam --

Column 4,
Line 17, "Aurapel330R" should read -- Aurapel 330R --
Line 20, "surfonyls" should read -- sulfonyls --
Line 36, "FerroCorpora-" should read -- Ferro Corpora- --
Line 57, "celluosic" should read -- cellulosic --

Column 6,
Line 52, "Jopplin, Mo." should read -- Joplin, Mo. --

Signed and Sealed this

Seventh Day of October, 2003

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

Exhibit 4

US006673432B2

(12) **United States Patent**
Kiik et al.

(10) **Patent No.: US 6,673,432 B2**
(45) **Date of Patent: *Jan. 6, 2004**

(54) WATER VAPOR BARRIER STRUCTURAL ARTICLE

(75) Inventors: **Matti Kiik**, Richardson, TX (US); **Daniel LaVietes**, DeSoto, TX (US); **Younger Ahluwalia**, DeSoto, TX (US)

(73) Assignee: **Elk Premium Building Products, Inc.**, Dallas, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 147 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/897,308**

(22) Filed: **Jul. 2, 2001**

(65) **Prior Publication Data**

US 2002/0160210 A1 Oct. 31, 2002

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/663,255, filed on Sep. 15, 2000, now Pat. No. 6,586,353.

(60) Provisional application No. 60/168,057, filed on Nov. 30, 1999.

(51) **Int. Cl.**^{7} **B32B 15/14**; B32B 27/00

(52) **U.S. Cl.** **428/301.1**; 428/297.4; 428/300.7; 428/457; 428/458; 428/461; 428/463

(58) **Field of Search** 428/457, 458, 428/461, 141, 297.4, 300.7, 463, 301.1

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Primary Examiner—Monique R. Jackson
(74) *Attorney, Agent, or Firm*—Baker Botts L.L.P.

(57) **ABSTRACT**

A structural article comprises a substrate having an ionic charge coated on one side with a coating having essentially the same ionic charge and covered on the other side with a water vapor impermeable material selected from the roof consisting essentially of metal foils and preformed plastic films. The coating consists essentially of a filler material and a binder material and the binder material bonds the filler material together and to the substrate. The water vapor impermeable material is attached to the coated substrate with an adhesive. In additional embodiments, the substrate is coated on both sides with a coating having essentially the same ionic charge and the article so coated is then covered on one or both sides with the water vapor impermeable material.

12 Claims, No Drawings

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WATER VAPOR BARRIER STRUCTURAL ARTICLE

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of pending U.S. application Ser. No. 09/663,255 filed on Sep. 15, 2000, now U.S. Pat. No. 6,536,353, which claims priority under 35 U.S.C. § 119(e) to Provisional Application No. 60/168,057, filed Nov. 30, 1999.

BACKGROUND OF THE INVENTION

This invention relates to structural articles which include water vapor impermeable materials such as metal foils and preformed plastic films. Those structural articles of the present invention which include metal foils may also be useful as radiant energy barriers and as flame and heat dissipating barriers.

For many years substrates such as fiberglass have been coated with various compositions to produce structural articles having utility in, among other applications, the building industry. U.S. Pat. No. 5,001,005 relates to structural laminates made with facing sheets. The laminates described in that patent include thermosetting plastic foam and have planar facing sheets comprising 60% to 90% by weight glass fibers (exclusive of glass micro-fibers), 10% to 40% by weight non-glass filler material and 1% to 30% by weight non-asphaltic binder material. The filler materials are indicated as being clay, mica, talc, limestone (calcium carbonate), gypsum (calcium sulfate), aluminum trihydrate (ATH), antimony oxide, cellulose fibers, plastic polymer fibers or a combination of any two or more of those substances. The patent further notes that the filler materials are bonded to the glass fibers using binders such as urea-, phenol- or melamine-formaldehyde resins (UF, PF, and MF resins), or a modified acrylic or polyester resin. Ordinary polymer latexes used according to the disclosure are Styrene-Butadiene-Rubber (SBR), Ethylene-Vinyl-Chloride (EVCl), Polyvinylidene Chloride (PVDC), modified Polyvinyl Chloride (PVC), Polyvinyl Alcohol (PVOH), and Polyvinyl Acetate (PVA).

U.S. Pat. No. 4,745,032 discloses an acrylic coating comprised of one acrylic underlying resin which includes fly ash and an overlying acrylic resin which differs from the underlying resin. U.S. Pat. No. 4,229,329 discloses a fire retardant coating composition comprising fly ash and vinyl acrylic polymer emulsion. The fly ash is 24 to 50% of the composition. U.S. Pat. No. 4,784,897 discloses a cover layer material on a basis of matting or fabric which includes calcium carbonate powder and a polystyrene-butadiene dispersion.

Many different coating compositions have been formulated over the years but often such compositions would bleed through substrates, such as fiberglass substrates, if the substrates were coated on just one side, unless the compositions had a high binder content and/or included viscosity modifiers to enhance the viscosity of the coating composition. To prevent bleed through, such coating compositions sometimes had their viscosity increased by blowing or whipping air into the compositions. Although such blown compositions did not bleed through to the other side of mats such as fiberglass mats, the raw material costs for the compositions were high because of the numbers of constituent elements involved.

U.S. Pat. No. 5,965,257 discloses a structural article having a coating which includes only two major constituents, while eliminating the need for viscosity modifiers, for stabilizers or for blowing. The structural article of U.S. Pat. No. 5,965,257 is made by coating a substrate having an ionic charge with a coating having essentially the same iconic charge. The coating consists essentially of a filler material and a binder material. By coating the substrate with a coating having essentially the same ionic charge, the patentee developed a zero bleed through product while using only two major ingredients in the coating and eliminating the need for costly and time consuming processing steps such as blowing. Structural articles may thus be produced having a low binder content and no viscosity modifiers. U.S. Pat. No. 5,965,257 issued to Elk Corporation of Dallas, the assignee of the present application. Elk produces a product in accordance with the invention of U.S. Pat. No. 5,965,257 which is marketed as VersaShield®.

As indicated in U.S. Pat. No. 5,965,257, VersaShield® has many uses, including utility as a moisture barrier. However, it has been found that the products of U.S. Pat. No. 5,965,257 are unable to provide a satisfactory water vapor barrier. In newly constructed office buildings, owners and tenants frequently desire to have carpeting layed down on concrete floors before sufficient time has passed for the concrete to completely cure. As a result, the water vapor which rises from the concrete often stains the carpet, requiring costly cleaning and/or removal. Although the products of U.S. Pat. No. 5,965,257 provide a moisture barrier, they do not provide a sufficient water vapor barrier and accordingly, they cannot satisfactorily serve in applications where vapor barriers are important, such as in interplies or underlayment between incompletely cured concrete floors and carpeting. The applicants have discovered, however, that by covering the structural articles of U.S. Pat. No. 5,965,257 with metal foils or preformed plastic films, the covered structural articles become essentially water vapor impermeable. Additionally, the applicants have discovered that when the structural articles of U.S. Pat. No. 5,965,257 are covered with metal foils, the structural articles also may be useful as radiant energy barriers and as flame and heat dissipating barriers.

SUMMARY OF THE INVENTION

In accordance with the invention, a structural article is made by coating one side of a substrate having an ionic charge with a coating having essentially the same ionic charge and covering the other side of the substrate with a water vapor impermeable material selected from the group consisting essentially of metal foils and preformed plastic films. The aforementioned coating consists essentially of a filler material and a binder material. The binder material bonds the filler material together and to the substrate. The coating does not bleed through the substrate. The water vapor impermeable material is attached to the other side of the substrate with an adhesive. Alternatively, structural articles may be made by coating both sides of a substrate having an ionic charge with a coating having essentially the same ionic charge. Again, the coating consists essentially of a filler material and a binder material, the coating does not bleed through the substrate and the binder material bonds the filler material together and to the substrate. In such embodiments, one side of the coated substrate is covered with a water vapor impermeable material selected from the group consisting essentially of metal foils and preformed plastic films. Again, the material is attached to the coated substrate with an adhesive. In other embodiments, one side of the coated substrate is covered with a metal foil water

vapor impermeable material and the other side of the coated substrate is covered with a preformed plastic film water vapor impermeable material. Both materials are attached to the coated substrate with an adhesive. In further embodiments, both sides of the coated substrate are coated with the same water vapor impermeable material.

The adhesive which is used to attach the water vapor impermeable material to the substrate, or to the coated substrate as the case may be, is selected from the group consisting essentially of low density polyethylene, high density polyethylene, polyethylene-vinyl acetate, polyesters polypropylene, polyvinylidene chloride, nylon and mixtures thereof.

In one embodiment, the coating is from 84% to 96% filler selected from the group consisting of fly ash, charged calcium carbonate, ceramic microspheres and mixtures thereof and from 16% to 4% acrylic latex binder materials. The coating may further include SBR rubber. The acrylic latex binder and the rubber may be cross-linked. In certain embodiments, the substrate consists essentially of glass fibers bonded together by a mixture of from 99% to 75% urea formaldehyde resin and from 1% to 25% acrylic latex.

The coated substrate of the present invention may be any suitable reinforcement material capable of withstanding processing temperatures, such as glass fibers, polyester fibers, cellulosic fibers, asbestos, steel fibers, alumina fibers, ceramic fibers, nylon fibers, graphite fibers, wool fibers, boron fibers, carbon fibers, jute fibers, polyolefin fibers, polystyrene fibers, acrylic fibers, phenolformaldehyde resin fibers, aromatic and aliphatic polyamide fibers, polyacrylamide fibers, polyacrylimide fibers or mixtures thereof which may include bicomponent fibers.

The filler may be class F fly ash wherein 90% to 95% by weight of the fly ash is aluminosilicate. Such a fly ash, known as Alsil 04TR, is produced by JTM Industries of Kennesaw, Ga. Alternatively, the filler may be charged calcium carbonate or ceramic microspheres, or a blend of fly ash and calcium carbonate, or a blend of fly ash, calcium carbonate and ceramic microspheres or any combination of these filler materials to meet desired cost and weight criteria. Calcium carbonate and fly ash filler increase the weight of the product, but utilization of ceramic microspheres enables the manufacture of a product with reduced weight and increased fire resistant properties. Ceramic microspheres can withstand heat greater than 2000° F. Also, ceramic microspheres increase compressive strength, absorb no latex and/or water and thus permit the faster drying of the product. Ceramic microspheres also increase product flexibility.

Further, the ceramic microspheres help to increase the pot life of the coating. Larger agglomerates in the calcium carbonate and fly ash filler, although they may comprise but a small percentage of the particles in the filler, have a tendency to settle near the bottom of a storage vessel. When ceramic microspheres are mixed together with calcium carbonate and/or fly ash filler, a dispersion is produced which has an increased pot life or shelf life. Without wishing to be bound by any particular theory, it is believed that as the filler particles naturally fall in the vessel and the ceramic microspheres rise, the more dense filler particles are supported by the low density ceramic microspheres, thus enabling the microspheres to stay in suspension and preventing the filler particles, to at least some extent, from descending to the bottom of the vessel.

The table below provides, in percentages, some of the combinations of calcium carbonate, fly ash and ceramic microspheres which applicant has utilized as the filler component in the coating:

TABLE I

	A %	B %	C %	D %	E %	F %
1. Water	18.9	25.9	30.87	25.9	24.9	24.9
2. Acrylic Latex	6.0	6.0	9.20	6.0	6.0	6.0
3. Fly Ash	75.0	34.0	—	40.0	—	20.0
4. $CaCO_3$	—	34.0	55.07	—	40.0	20.0
5. Microspheres	—	—	4.76	29.0	29.0	29.0
6. Defoamer	0.1	0.1	0.1	0.1	0.1	0.1
	100%	100%	100%	100%	100%	100%

The microspheres were a 50/50 ratio of 3M's W1012 microspheres and 3M's smaller diameter G200 microspheres or 100% 3M's G-3500 microspheres. Although the table shows possible combinations of calcium carbonate, fly ash and ceramic micro spheres in the filler component of the coating, it is believed that any combination of these materials may be employed.

The coating is prepared by using a binder material such as a high performance heat-reactive acrylic latex polymer to bond the filler materials together and to bond the filler to the substrate. Such a binder material is Hycar 2679 acrylic latex polymer supplied by B. F. Goodrich Company of Cleveland, Ohio. It is believed, however, that any linear polymer, linear copolymer or branched polymer may be useful in preparing the coating. Possible binder materials include butyl rubber latex, SBR latex, neoprene latex, polyvinyl alcohol copolymer emulsions, SBS latex, water based polyurethane emulsions and elastomers, vinyl chloride copolymers, nitrile rubbers and polyvinyl acetate copolymers.

In a preferred embodiment the coating comprises nearly 85% by weight of the structural article. In that coating, approximately from 84% to 96% by weight is filler and the remainder is the acrylic latex binder. The filler is approximately 92% charged calcium carbonate and 8% ceramic microspheres. The substrate comprises about 15% by weight of the structural article. Glass fibers comprise approximately 12% by weight of the article and a binder material comprises about 3% by weight of the article. The binder which bonds together the glass fibers is from 99% to 75% (preferably 98% to 94%) by weight urea formaldehyde resin and from 1% to 25% (preferably 2% to 6%) by weight standard acrylic latex.

The substrate may be coated by air spraying, dip coating, knife coating, roll coating or rotogravure printing. The coating may be bonded to the substrate by chemical bonding, mechanical bonding and/or thermal bonding. Mechanical bonding is achieved by force feeding the coating onto the substrate with a knife.

Structural articles made in accordance with this invention may be of any shape and may be used in any of a variety of products. Preferably, such articles are planar in shape. The substrate is coated on one side or both sides depending on the intended application. For instance, if one side of the substrate is coated with the filler/binder coating, the other surface can be covered with the appropriate water vapor impermeable material.

DETAILED DESCRIPTION

Structural articles are made by coating a substrate having an anionic charge with a coating having essentially the same ionic charge. Any suitable reinforcement material capable of withstanding processing temperatures may be employed as a substrate in accordance with the invention. Examples

include, inter alia, glass, fiberglass, ceramics, graphite (carbon), PBI (polybenzimidazole), PTFE, polyaramides, such as KEVLAR and NOMEX, metals including metal wire or mesh, polyolefins such as TYVEK, polyesters such as DACRON or REEMAY, polyamides, polyimides, thermoplastics such as KYNAR and TEFZEL, polyether sulfones, polyether imide, polyether ketones, novoloid phenolic fibers such as KYNOL, cotton, asbestos and other natural as well as synthetic fibers. The substrate may comprise a yarn, filament, monofilament or other fibrous material either as such or assembled as a textile, or any woven, non-woven, knitted, matted, felted, etc. material. The polyolefin may be polyvinyl alcohol, polypropylene, polyethylene, polyvinyl chloride, polyurethane, etc. alone or in combination with one another. The acrylics may be DYNEL, ACRILAN and/or ORLON. RHOPLEX AC-22 and RHOPLEX AC-507 are acrylic resins sold by Rohm and Haas which may also be used. The cellulosic fibers may be natural cellulose such as wood pulp, newsprint, Kraft pulp and cotton and/or chemically processed cellulose such as rayon and/or lyocell.

The fly ash may be obtained from JTM Industries, Inc. of Martin Lake and Jewett, Tex. and preferrably has particle size such that less than 0.03% remains on an agitated 0.1 inch×0.1 inch screen. Ceramic microspheres are manufactured by Zeelan Industries of 3M Center Bldg., 220-8E-04, St. Paul, Minn. 55144-1000. Calcium carbonate may be obtained from Franklin Industrial Minerals of 612 Tenth Avenue North, Nashville, Tenn. 37203.

Substrates having an ionic charge were coated on one and both sides with a coating having essentially the same ionic charge in the manner described in U.S. Pat. No. 5,965,257 the entire disclosure of which is incorporated herein by reference. As noted above, the one and two sided coated structural articles are available as the product VersaShield® from the Elk Corporation of Dallas. The one or two sided coated structural article is then coated with an adhesive so that the water vapor impermeable material may be attached thereto. In a preferred embodiment, the coated structural article runs on a traditional line where a hot melt adhesive is extruded onto it. Water vapor impermeable metal foil and/or preformed plastic film is then applied from preformed rolls via a press roll and a chiller roll which serve to press the foil or the film onto the adhesive covered coated structural article and then chill the product immediately. Although the adhesive may be applied by any traditional means, such as spraying or hand brushing, applicants' preferred method of applying the adhesive is by extruding a hot thin film. Utilizing an extruder enables one to include a variety of components which are available in pellet form, such as color additives, antioxidants, flame retardants and other constituents.

The adhesive may be any substance capable of adhering the water vapor impermeable material to the coated substrate. Preferred adhesives are those which are capable of hot film extrusion, such as those selected from the group consisting essentially of low density polyethylene, high density polyethylene, polyethylene-vinyl acetate, polypropylene, polyvinylidene chloride, polyester, nylon and mixtures thereof. Applicants' preferred adhesive is a hot polyethylene film extruded onto the coated substrate.

The preformed plastic film is a cold preformed film having a thickness ranging from 0.5 mil to 4 mil. Preformed high density polyethylene, polypropylene and vinyl acetate films may be used, as may any other preformed plastic film having water vapor impermeable characteristics. The thickness of the film is determined by the permeability requirements of the final application. The term "water vapor impermeable material" as used herein by applicants does not mean that the material must satisfy zero g/m^2/24 hr water vapor permeability requirements. Rather, the term means materials that satisfy water vapor permeability requirements from 0 to 5 g/m^2/24 hr. Water vapor transmission values for various tested materials are provided below:

EXAMPLE I

A coating prepared with the ingredients and percentages described in composition "C" of Table I was used to coat a fiberglass mat on one side. The mat was manufactured by Elk Corporation of Ennis and had a basis weight of 1.7 lb/100 ft^2 (1.7 lb/sq.). The dry weight of coating applied was 9.3 lb/sq. ("Coated Mat I").

A 0.002 inch (2 mil) preformed film of high density polyethylene (HDPE) was laminated to the uncoated side of Coated Mat I using 0.6 lb/sq of linear low density polyethylene extrudate as the adhesive.

EXAMPLE II

In the same manner as Example I, a 1.7 lb/sq fiberglass mat was coated on both sides with coating "C" of Table I. The total dry weight of coating applied was 16.4 lb/sq. ("Coated Mat II").

A 0.002 inch (2 mil) preformed film of high density polyethylene (HDPE) was laminated to the second-coated side of Coated Mat II using 0.6 lb/sq of linear low density polyethylene extrudate as the adhesive.

EXAMPLE III

Aluminum foil, 0.0003 inch (0.3 mil), was laminated to the uncoated side of Coated Mat I using 0.6 lb/sq. of linear low density polyethylene extrudate as the adhesvie.

EXAMPLE IV

Aluminum foil, 0.003 inch (0.3 mil), was laminated to the second-coated side of Coated Mat II using 0.6 lb/sq. of linear low density polyethylene extrudate as the adhesive.

Water Vapor Transmission Rate Test Procedure

The procedure used is essentially that described in ASTM E-96. About 30 grams of water are placed in a Vapometer cup (Thwing-Albert, Philadelphia, Pa.). A diecut 3.00 inch diameter test specimen is placed in the flange at the top of the cup, the gasketed flange cover is positioned over the specimen and the six machine screws are tightened with a plier. The entire cup assembly is weighed on an analytical balance.

The Vapometer cup assembly is placed in a dessicator containing Drierite (anhydrous calcium sulfate). After about seven days (the exact time is recorded), the Vapometer cup assembly is removed from the dessicator and reweighed. The water vapor transmission rate (WVT) in grams per square meter per 24 hours (g/m^2/24 hr) is calculated from the exposed area of test specimen, the loss in water weight from the cup and the time.

TABLE II

WATER VAPOR TRANSMISSION VALUES

Coated Product Designation	Water Vapor Transmission Rate ($g/m^2/24$ hr)
Coated Mat I	394.9
Coated Mat II	383.5
Example I	0.9
Example II	0.9
Example III	4.3
Example IV	2.3

The water vapor impermeable metal foil material may be aluminum, copper, zinc or any other metal that may be formed into a light weight pliable foil. The thickness of the foils is preferably 0.5 mil or less. The water vapor impermeable metal foil(s) or preformed plastic film(s) may be applied to both sides of a coated substrate by applying the material to one side as described above and then repeating the process on the other side. In such cases, the metal foils covering the two sides of the coated substrate may be the same or different. Similarly the same or different preformed plastic films may cover the two coated sides of the substrate. Also a water vapor impermeable metal foil may be applied on one side of the coated substrate and a water vapor impermeable plastic film may be applied on the other side of the coated substrate.

As noted above, the structural articles of the present invention are particularly well suited for carpet installations on damp concrete. When the structural articles are employed as such carpet underlayments, or interplies, it is believed that the coated portion of the article absorbs water and water vapor, and the water vapor impermeable material protects the carpet from staining.

Typical properties of the inventive carpet underlayments or interplies are provided in Table III below:

TABLE III

Basis Weight (lb/100 ft^2)	19.3
(g/m^2)	942
Thickness (mil)	42
(mm)	1.07
Frazier Porosity (cfm/ft^2)	<1.0
Tensile Strength MD	90
(lb/1" width) CD	44
Elmendorf Tear MD	638
(gram) CD	1374
Moisture Vapor Transmission (lb/1000 ft^2/24 hr)	0.19
Water Shower Test-4 Hours	Pass

Moisture vapor transmission tests were preformed according to ASTM E-96 using Vapometer cups. Water was placed in the cups and Drierite in the dessicator for a 100% to 0% gradient across the test specimen.

The preferred carpet underlayment configuration is to place the film or foil side up. The coating on the other side absorbs moisture from the concrete, while the foil or film provides an impervious moisture barrier on which the carpet may be placed. Seaming the underlayment may be achieved using adhesive or a waterproof tape. Overlapping the underlayment layers is not recommended because the 42–44 mil thickness of each layer may result in an uneven surface which could allow moisture vapor transmission.

Structural articles of the present invention covered with water vapor impermeable metal foils may also serve as radiant energy barriers. Possible uses include applying the radiant barrier to a roof (with the foil side up) for utilization under roofing shingles and applying the radiant barrier in the attic of a dwelling with the foil side of the structural article placed up against the rafter. Because the coating on one side of the radiant barrier structural article protects the foil film, thinner and therefore less expensive foil film may be used to provide radiant barriers in a number of applications. For instance, the structural article of the applicants' invention can be cut into strips and wrapped around hot pipes in e.g., oil fields, industrial facilities and buildings. If the foil is placed against the pipe, it is protected by the tough, durable coating on the other side of the substrate and heat is radiated back into the pipe thus reducing energy costs.

The structural articles of the present invention covered with vapor impermeable metal foils may also serve as flame and heat dissipating barriers. Possible uses include combinations with hardboard for use in office partition panels and similar constructions to meet product flammability standards. In such embodiments, the article may be attached to the hardboard to achieve a resulting product that is a flame and heat dissipating barrier in office partition panels. The hardboard may be a ⅛" to ⅜" hot-pressed composite of wood and paper fibers and phenol-formaldehyde resin. The article may be attached to the hardboard by use of adhesives or well known fasteners such as nails or screws. Preferably, the article is laminated to the hardboard by well known lamination techniques to produce a resulting laminate flame and heat dissipating barrier.

Additionally, the structural articles of the invention may be used as relatively low cost thin foil film hygienic barriers in, e.g. the dairy industry at the point of raw milk collection.

It should be understood that the above examples are illustrative and that compositions other than those described above can be used while utilizing the principles underlying the present invention.

We claim:

1. A structural article comprising a substrate having an ionic charge,

(a) coated on one side with a coating having essentially the same ionic charge wherein said coating consists essentially of a filler material and a binder material and wherein said binder material bonds the filler material together and to the substrate and wherein said coating does not bleed through said substrate; and

(b) covered on the other side with a water vapor impermeable coating comprising a material selected from the group consisting of metal foils and preformed plastic films;

wherein said material is attached to said coated substrate with an adhesive.

2. A structural article comprising a substrate having an ionic charge coated on both sides with a coating having essentially the same ionic charge wherein said coating consists essentially of a filler material and a binder material and wherein said binder material bonds the filler material together and to the substrate and wherein said coating does not bleed through said substrate;

wherein one side of said coated substrate is covered with a water vapor impermeable coating comprising a material selected from the group consisting of metal foils and preformed plastic films; and

wherein said material is attached to said coated substrate with an adhesive.

3. A structural article according to claim 2, wherein one side of said coated substrate is covered with a metal foil

water vapor barrier material and the other side of said coated substrate is covered with a preformed plastic film water vapor impermeable material; and wherein both water vapor impermeable materials are attached to said coated substrate with an adhesive.

4. A structural article according to claim 2, wherein both sides of the coated substrate are coated with a metal foil water vapor impermeable material and wherein said water vapor impermeable material is attached to said coated substrate with an adhesive.

5. A structural article according to claim 2, wherein both sides of the coated substrate are coated with a preformed plastic film water vapor impermeable material and wherein said water vapor impermeable material is attached to said coated substrate with an adhesive.

6. A structural article according to claims 1, 2, 3, 4 or 5 wherein said adhesive is selected from the group consisting of low density polyethylene, high density polyethylene, polyethylene-vinyl acetate, polypropylene, polyvinylidene chloride, nylon, polyester and mixtures thereof.

7. A structural article according to claim 6, wherein said coating is from 84% to 96% filler selected from the group consisting of fly ash, charged calcium carbonate, ceramic microspheres and mixtures thereof and from 16% to 4% acrylic latex binder material.

8. A structural article according to claim 7, wherein said coating further includes SBR rubber.

9. A structural article according to claim 8, wherein said acrylic latex binder and said rubber are cross linked.

10. A structural article according to claim 9, wherein said substrate consists essentially of glass fibers bonded together by a mixture of from 99% to 75% urea formaldehyde and from 1% to 25% acrylic latex.

11. A structural article according to claim 6 wherein said article is a carpet underlayment.

12. A structural article according to claim 6 wherein said article is attached to hardboard.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,673,432 B2
DATED : January 6, 2004
INVENTOR(S) : Kiik et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [57], **ABSTRACT**,
Line 4, "roof" should read -- group --

Column 1,
Line 8, "6,536,353" should read -- 6,586,353 --

Column 4,
Line 19, "micro spheres" should read -- microspheres --

Column 5,
Line 22, "preferrably" should read -- preferably --

Column 6,
Line 40, "adhesvie" should read -- adhesive --

Signed and Sealed this

Twenty-eighth Day of December, 2004

Jon W. Dudas

JON W. DUDAS
Director of the United States Patent and Trademark Office